Technical Guide
Wiring Diagrams

GUIDES, WIRING DIAGRAMS

REFERENCE STANDARDS

UNI 13779:2005 "Ventilation for non residential buildings – Performance requirements for ventilation and room conditioning systems" The quality of indoor air obtained is classified by the standard under 4 categories, from IDA 1 (high quality) to IDA 4 (low quality). To obtain the air quality required, certain air flow rates need to be ensured. Comfort and air quality criteria must be met only in the occupied zone, and not in the entire volume of the room.

The quality of the air can be assessed by conducting a classification test based on:
- concentration of CO,
- concentration of specific pollutants,
- air quality perceived by occupants,
- air renewal rate per person occupying the room,
- air renewal rate overall

CATEGORY	UNIT	NO SMOKING AREA	SMOKING AREA
IDA 1	m^3/h pers. litri/s pers	>54 >15	>108 >30
IDA 2	m^3/h pers. litri/s pers	36-54 10-15	72-108 20-30
IDA 3	m^3/h pers. litri/s pers	22-36 6-10	43-72 12-20
IDA 4	m^3/h pers. litri/s pers	<22 <6	<43 <12

LEGISLATION AND STANDARDS

The fresh air requirement per person is expressed in m^3/h. Both in dwellings and in offices, an air supply of between 22 and 54 m3/h is recommended; this can be reduced to around 36 m3/h where controlled mechanical ventilation is installed. Higher rates of flow are required in more crowded spaces (meeting rooms, canteens, restaurants) or in special cases (e.g. smoking rooms, for which there are specific regulations such as — in the case of Italy — Law n° 3 of 16 January 2003).
It should be emphasized that technical standards are not "binding"; until the standard is incorporated into a law or regulation, it remains a reference and application is not compulsory.

Standard UNI 10339 "Air handling systems for occupant well-being. General information, classification and requirements.
Rules for bid requests, proposals, orders and supply".
A ventilation system, whether mechanical or natural, must guarantee:
• introduction of a minimum quantity of outside air, depending on the type of room;
• minimum conventional filtration of outside air and recirculated air;
• circulation of air within the conventional occupied volume of space (the occupied zone is defined as that part of the room delimited by the floor, by a horizontal surface located at 1.8 m above the floor, and by vertical surfaces located at 0.6m from the walls and from HVAC appliances).

Law n° 3 of 16 January 2003 protects the health of non smokers.
Article 51 bans smoking in all enclosed rooms with the exception of:
• private rooms not open to users or to the public,
• rooms allocated for the use of smokers and signposted accordingly. The ban affects any private business activity (sales and services) conducted using enclosed premises (not having any part permanently connected to the outdoors) and open to the public, without formalities and with no need for special permits, during business hours. Smoking rooms are subject to certain structural requirements, which must be met in the case of enclosed spaces in business premises and workplaces, allocated for the use of smokers and signposted accordingly.

Technical requirements
Smoking rooms must be:

• delimited by walls of full height on all four sides,
• equipped with an entrance having an automatically closing door, normally in the closed position,
• provided with clearly visible signage indicating the words "SMOKERS AREA" and, in the event of auxiliary ventilation systems operating inefficiently or breaking down completely, "SMOKING PROHIBITED DUE TO VENTILATION SYSTEM FAILURE", which will automatically conceal or deactivate the "smokers area" sign,
• located so as not to coincide with any transit zones used by non smokers,
• provided at the entrance with a sign indicating the maximum number of persons permissible according to the capacity of the ventilation system,
• depressurized permanently at a level not less than 5 Pa,
• in the case of foodservice, proportioned so that the floor space set aside for smokers is less than half of the overall floor space utilized for the business operation.

Ventilation system specifications.
The ventilation systems used must be:

• equipped with mechanical forced ventilation means able to guarantee a sufficient replacement flow either of additional air from outside the building, or of air transferred from other neighbouring rooms where smoking is prohibited,
• able to ensure that the flow of replacement air is properly filtered,
• able to ensure that the minimum flow of additional air provided will be equivalent to 30 l/s per single person, based on a crowding index of 0.7 persons/m^2,
• configured in such a way that air extracted from smoking rooms is exhausted to the external environment by way of suitable treatment systems and not recirculated within the building.

Signage
In rooms where smoking is prohibited, this must include:

• signs with the words "NO SMOKING".

Directive ATEX 94/9/EC
Equipment and protective systems intended for use in potentially explosive atmospheres - safety requirements. In essence, this Directive defines the technical and manufacturing requirements for all appliances such as machines, fans, fixed and movable devices, ducting and valves, to be used in environments that are classified as

REFERENCE REGULATIONS

potentially explosive in accordance with the following Directive.

Directive 1999/925/CE minimum requirements for improving the health and safety of workers who may be exposed to risks associated with explosive atmospheres.
To comply with the Directive, employers are obliged to carry out or commission an explosion risk assessment inside the company premises, which must be conducted by persons certified to perform the type of assessment in question. Certain areas may be classified as subject to different levels of risk that call for different, and in some cases, special protection systems.
The areas can be classified depending on whether there is Gas or Dust (G/D) present. In our case, the fans utilized will be designed and manufactured in compliance with Directive ATEX 94/9/EC.

The determination of the European Union to promote an increasingly effective use of energy resources — with the threefold aim of reducing dependence on non-renewable sources, minimizing emissions of pollutant gases and encouraging European companies to be competitive by favouring the development of leading edge technologies and limiting the spread of lower cost and less sophisticated products coming from other geographical areas — has found expression over recent years in the following Directives:
• **2009/125/EC**, establishing a framework for the setting of ecodesign requirements for energy-related products;
• **2010/31/EU**, on the energy performance of buildings. Following the publication of these directives and their subsequent harmonization by member countries of the EU, manufacturing companies have been engaged in an intense programme of development dictated by the need to align their offering as swiftly as possible with the changing demands of the market now materializing with the recognition and adoption of new standards.

Directive 2009/125/EC ErP (Energy related Products) amends and expands the content of the previous **Directive 2005/32/ EC EuP** (Energy using Products), establishing a framework in which to develop European specifications for the eco-compatible design of products (except for passenger and goods transport vehicles), connected with energy, in a bid to guarantee the free circulation of such products throughout the internal market. It envisages the preparation of specifications with which products affected by the measures introduced must comply in order to be placed on the market and/or put into service. The Directive is intended to "contribute to sustainable development by increasing energy efficiency and the level of protection of the environment, while at the same time increasing the security of the energy supply".
Companies affected are also asked to apply design criteria designed to reduce the environmental impacts of products across all the steps of their life cycle.
To this end, design engineers use Life Cycle Assessment (LCA) techniques allowing them to analyze the environmental impact of a given appliance, from the extraction and transformation of raw materials, through production, transport and utilization to ultimate disposal.
The Directive is based on awareness that the level of pollution generated during the product's life cycle can actually be predicted at the design stage. By improving the energy efficiency of products, manufacturers can also help to guarantee the security of energy procurement, a precondition indispensable for solid and sustainable economic activity.

Directive 2009/125/EC ErP is implemented in practice as a set of Regulations, drafted by EU-appointed Committees of experts and dealing with the different types of appliances involved, which define the minim design requirements that must be observed by manufacturers in order to deliver efficient products having a low environmental impact, based on increasingly stringent criteria intended to gain advantage and at the same time promote technological progress.
Each Regulation has the status of European Law, giving it precedence over any conflicting regulations or standards that may be adopted by single member states and establishing its legal effect as from the date of promulgation, with no need for subsequent harmonization by single Parliaments. Among the Regulations already promulgated, of particular interest to the HVAC sector are those relating to:
• Fans for non-residential applications,
• Household air conditioners,
• Fans for warm weather comfort,
• Stand by.

Regulation (EC) n° 327/2011
Relates to the eco-compatible design of fans with electrical input at a Best Efficiency Point (BEP) of between 125 W and 500 kW, fixing a minimum efficiency value for each type of appliance available on the market:
• axial flow fans
• centrifugal fans
• mixed flow fans (centrifugal/ propeller)
• tangential flow fans
From 1° January 2013, the date the regulation came into effect, it will no longer be possible for fans rated at less than the minimum permissible efficiency to be placed on the market and/or put into service in EU member countries. The minimum limit will be raised further with effect from 01/01/2015.

Regulation (EC) n° 1275/2008
Stand By - This regulation places a limit on levels of electrical power consumption in Stand-by mode (any condition providing only the reactivation function, or only the reactivation function and a simple indication that the reactivation function is enabled), and Off mode. With effect from 07/01/2013 the following specifications must be observed:

- **Electrical power consumption in "Off mode"** < 0.5 W
- Electrical power consumption in "Stand-by mode" < 0.5 W
- Electrical power consumption in any condition that provides only a display of information or status, or only the combination of the reactivation function and a display of information or status, < 1.0 W.

Directive 2010/31/EU Directive 2010/31/EU, which relates to the energy performance of buildings, promotes improvement of the energy performance of buildings, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.
The provisions of the Directive are concerned with: the common general framework of a methodology for calculating the integrated energy performance of buildings and building units; the application of minimum requirements to the energy performance of new buildings and new building units; the application of minimum requirements to the energy performance of: IX
- existing buildings, building units and building elements that are subject to major renovation;
- building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are retrofitted or replaced;
- technical building systems whenever they are installed, replaced or upgraded;
- national plans for increasing the number of nearly zero-energy buildings;
- energy certification of buildings or building units;
- regular inspection of heating and air-conditioning systems in buildings;
- independent control systems for energy performance certificates and inspection reports.

Worthy of interest among regulations implementing the Directive is n° 626/2011, which takes the place of the previous Directive on energy labelling of household air-conditioners, 2002/31/EC.
Regulation (EC) n° 626/2011
This regulation establishes that, with effect from 01/01/2013, air conditioners placed on the European market shall be identified by a new Energy Label, indicating three new classes (A+, A++ and A+++) and determining the exclusion (phased out gradually in the case of split and multi split appliances, eliminated immediately in the case of those having no outdoor unit), of products in classes E, F and G.

VENTILATION

VENTILATION EFFICIENCY

Ventilation is not always organized correctly, and this can mean that whilst the air flow rate may be the same, one room may be better ventilated than another room of similar volume and layout, and consequently have a better quality of air.
The efficiency of ventilation is defined as the capacity of a ventilation system to remove pollutants from a confined environment. A highly efficient system can therefore provide excellent air quality with a lower rate of air flow than a less efficient system. The efficiency of ventilation depends on certain factors, namely:
- specifications of the system,
- characteristics and positioning of air distribution terminals,
- type of room.

Efficiency is quantified by a non-dimensional parameter: values of less than 1 indicate the possible formation of "pockets" in the ventilated air space, which are refreshed less frequently than specified in the design.
The higher the ventilation efficiency value, the more the ventilation system guarantees a uniform mixture of air throughout the entire ventilated space (with the exception of the displacement ventilation system).
Where special turbulence diffusers are used, the ventilation efficiency value can be higher than 1: this means that the system is particularly efficient and that it is possible to reduce the overall air flow while ensuring that the room air will continue to be refreshed and consequently avoiding any unnecessary oversizing of the system. Indicated below are some conventional values for ventilation efficiency according to ASHRAE STANDARD 62.1-2004.

APPLICATION	VENTILATION EFFICIENCY
Cold supply air introduced at ceiling level	1.0
Warm supply air introduced at intake temperature of <8 °C compared to room temperature	1.0
Warm supply air introduced at intake temperature of >8 °C compared to room temperature	0.8
Supply air introduced at floor level and perfectly mixed	1.0
Cold supply air introduced at floor level with extraction at ceiling level (displacement ventilation)	1.2
Warm supply air introduced at floor level with extraction at ceiling level	0.7

WELL-BEING IN CONFINED ENVIRONMENTS

We spend a great deal of our time in closed or confined environments both at home and at work. In such settings, the temperature, relative humidity and concentration of pollutants can be very different from external conditions whether from the presence of others or from the effects of air-treatment systems in use in such environments.
The aim of heating/cooling/ ventilation systems is to recreate **conditions conducive to our well-being**.
The condition of *"thermohygrometric"* well-being is defined as the physical/ psychological state that an individual finds satisfactory regarding the surrounding micro-climate. The term "thermohygrometric" refers to our perceived sensations of temperature and humidity and, when we are in a state of **thermal neutrality,** we feel neither hot nor cold.

We need such a condition to feel comfortable and when our bodily temperature control system is in equilibrium and we are neither using nor losing internal energy. However, just providing this type of condition is not enough to make us feel comfortable. We may well experience conditions that satisfy all the requirements of thermal equilibrium but still feel hot or cold.

THE PMV INDEX

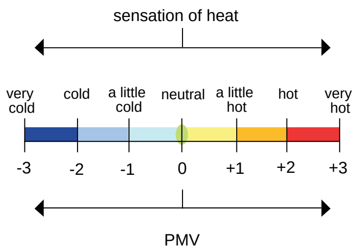
A number of different measuring systems have been introduced to clarify the situation. These systems analyse the the sensations of well-being or stress brought about by changes in certain factors that affect the micro-climate (i.e. changes in environmental parameters such as temperature, humidity and the rate of air-flow from an individual's point of view).

P. O. Fanger proposed the PMV (Predicted Mean Vote) Global Comfort Index that is a non-dimensional index for measuring well-being or stress. ASHRAE proposed a seven-point thermal sensation scale that allows individuals to award points to what they feel (fig. 2.02).

A score of 0 indicates a neutral comfortable sensation. Scores of +3, +2, +1, -1, -2, -3 are used to indicate degrees of dissatisfaction.

An individual's sensation of feeling hot or cold is proportional to the thermal load expressed in Watts

SCORE	SENSATION
+3	Very hot
+2	Hot
+1	Warm
0	Neutral
-1	Cool



L = (M-W) – Eres – Cres – E – C – R – K
where:
M = rate of metabolic heat production (W)
W = rate of mechanical work (W)
Eres = evaporative heat loss from respiration (W)
Cres = convective heat loss from respiration (W)
E = evaporative heat loss from skin (W)
C = heat loss by convection (W)
R = heat loss by radiation (W)
K = heat loss by conduction (W)

The factors that affect the the conditions of well-being are:

THE INFLUENCE OF VARIABLES ON COMFORT

There are six factors that contribute to an individual's degree of comfort in a confined environment (setting aside the mechanical energy used in carrying out a job) of which four are environmental and two are individual.

INDIVIDUAL FACTORS

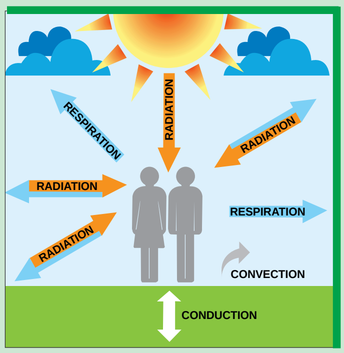
There are two individual variables that affect thermal equilibrium: metabolic output and the conductive/evaporative thermal resistance of clothing.

1) Metabolic output is usually expressed as the mean amount of energy lost per hour through the skin during physical activity.
Using the MET thermal unit where
1 MET = 58.15 W/m^2
and
1 Kcal/h = 1.163 W
ISO 7730 indicates the following characteristic values (taking the mean bodily surface of an individual to be 1.8 m^2):
The higher the MET index value, the greater the sensation of "hot" and the lesser the sensation of "cold".

2) The thermal resistance of clothing is measured with CLO units: One CLO is defined as a temperature gradient of 0.18 °C on an area of 1 m^2 with a heat flow of 1 Kcal/h (1 CLO = 0.155 m^2K/W).

ENVIRONMENTAL FACTORS
- temperature of the surrounding air, that affects convective thermal exchange
- mean radiant temperature, that affects radiating thermal exchange
- relative air speed, that affects convective thermal exchange
- relative air humidity, that affects evaporative thermal exchange in the body

INDIVIDUAL FACTORS
- metabolic rate M in relation to the activity carried out
- mechanical energy W used to carry out a job (usually overlooked)
- conductive and evaporative thermal resistance of clothing *(CLO)*



ACTIVITY	MET	W/m^2	Kcal/h
Lying down, relaxed	0.8	47	73
Seated, relaxed	1	58	90
Sedentary activity	1.2	70	108
Standing, relaxed	1.2	70	108
Light activity, standing	1.6	93	145
Medium activity, standing	2	117	182

The higher the CLO index value, the greater the sensation of “hot” and the lesser the sensation of “cold”.

Fig. 2.05

Naked	0 CLO
Shorts	0.1 CLO
Light summer clothes	0.5 CLO
Lightweight suit	0.7 CLO

AIR SPEED	LOWERING OF TEMPERATURE C°	SENSATION
< 0.25	< 1.0	None
0.26 - 0.50	1.1 - 1.6	Pleasant
0.51 - 0.	1.7 - 2.2	Pleasant with awareness of movement
0.76 - 1.00	2.3 - 2.8	From pleasant to slightly unpleasant
1.01 - 1.50	2.9 - 3.9	From slightly to very unpleasant
> 1.50	> 3.9	Corrective action needed

ENVIRONMENTAL

There are four environmental factors to consider:

1) Temperature of the surrounding air,
2) Mean radiant temperature,
3) Relative air speed,
4) Relative humidity in the air

1 – 2) In “thermally moderated” environments, the temperature of the air is very similar (if not in fact identical) to the radiant temperature. In this case, operating temperature is defined as the mean of the air and radiant temperatures. The operating temperature limits for winter and summer with a metabolic rate of 1.2 MET are:
• *summer from 23 to 26 °C (0.5 CLO)*
• *winter from 20 to 24 °C (1.0 CLO)*

3) The speed the air travels in an environment affects heat exchange by convection between an individual and the environment. The faster the air travels (with the other factors unaltered) the greater the feeling of discomfort. To restore conditions of well-being therefore, the operating temperature has to be changed. Acceptable air speed values are less than 1 m/s even if they rarely exceed 0.15 m/s in winter and 0.25 m/s in summer in occupied areas.

4) The generally recommended humidity values lie between 30% and 70% and these, per se, have less effect on the perception of comfort than other factors. At values of less than 30%, mucous secretions tend to dry up and thus lower our defence against germs and bacteria. On the other hand, if in excess of 70%, they can both cause allergies and affect the walls of buildings (through the possible formation of surface condensation and the appearance of mould at thermal bridges or at the coldest spots on that building’s insulation). ISO (International Organisation for Standardisation) recommends use of the PMV index where the following variations in environmental factors affect thermal equilibrium:
- energy output = 1-4 MET
- thermal resistance of clothing = 0-2 CLO
- dry bulb temperature = 10-30 °C
- mean radiant temperature = 10-40 °C
- air speed = 0-1 m/s
- vapour pressure = 0-2.7 kPa.

AIR QUALITY

The “thermohygrometric well-being” that we examined previously does not take another important factor in internal environments into consideration, namely air quality.

In its normal state, air is a mixture of the following gases:
- nitrogen (78%)
- oxygen (20.96%)
- argon and other gases (1.01%)
- carbon dioxide (0.03%)

It also contains a varying amount of water vapour. The percentage of carbon dioxide can vary from one geographical area to another while in urban areas, due to the effects of industry and traffic, pollution is higher and the air contains sulphur dioxide, nitrogen dioxide, carbon monoxide, lead compounds, fine particles etc...

OXYGEN (O_2)

Oxygen is essential for life and we can live breathing oxygen alone. A lack of oxygen leads to the appearance of symptoms such as lethargy and tiredness. A 25% decrease in oxygen supply can be dangerous for people suffering from respiratory or heart disease but if the decrease reaches 50%, even normally healthy people who are not acclimatised to this condition, can be at severe risk.

AIR QUALITY

NITROGEN AND INERT GASES (Ar, Ne, He, Kr, Xe)

Nitrogen, like argon and the other inert gases such as neon, helium, krypton and xenon, has no physiological effects.

CARBON DIOXIDE (CO_2)

Carbon dioxide does not cause significant effects on the human body but it does play an important role in defining the conditions of environmental well-being.
In confined environments, air purity is compromised by those occupying the area and by the activities they carry out. This includes both metabolic and "mechanical" activities performed by machinery in the area.
We exhale carbon dioxide while depleting the oxygen supply at the same time. The average amount of CO_2 exhaled by an individual is from 0.02 a 0.35 m^3/h depending on the type of activity.
The maximum limit of carbon dioxide concentration that the human body can tolerate has been estimated at 5% but we can experience various disturbances at lower levels.

WATER VAPOUR (H_2O)

Although an apparently harmless pollutant, in reality, the effect of water vapour should not be under-estimated due to a number of negative phenomena associated with it. Humidity can be absorbed by walls and affect their insulating properties. If there is excessive dampness in areas that are not well ventilated, moulds can form at the coldest points (thermal bridges, wall cavities, wardrobes etc…).

RADON (Rn)

Radon is an inert noble gas that is found in the Earth's crust gas. If inhaled, it is not absorbed by the body and is exhaled as we breathe. The harmful effects of Radon come from its radioactive "descendants" that, if inhaled, deposit on the bronchial epithelium and cause cancer of the respiratory tract. Outdoors, the concentration of Radon is very low but in closed or underground environments, it can reach dangerous levels.

CARBON MONOXIDE (CO)

The effects of carbon monoxide vary with the level of concentration and the higher the level, the more severe the effects. Symptoms of carbon monoxide poisoning include memory loss and attention deficit but can go on to cover cardiac crises and even death from asphyxia. In non-industrial confined environments, the concentration of CO is generally tied to air brought in from from outdoors that has been contaminated by traffic pollution. Other factors include tobacco smoke and the presence of heating or cooking appliances that are not properly ventilated.

OZONE (O_3)

Ozone at concentrations in excess of 0.05 ppm cause mucous secretions to dry up, headaches and at levels over 1.7 ppm even pulmonary oedema (fluid in the lungs).
The main source of ozone pollution in non-industrial confined environments is from the intensive use of photocopiers and laser printers. It should be borne in mind that it only takes a short time (about 30 minutes) for ozone levels to decrease by 50%.

AIRBORNE PARTICULATE

With every breath, particulate lodges in the alveoli in our lungs and along the respiratory tracts. These particles are then expelled through the mucus. Some harmful particles can however remain trapped in the alveoli and cause long-term complications.
Airborne particulate can also be responsible for the transfer of other chemical, physical and biological contaminants.

VOLATILE ORGANIC COMPOUNDS (VOC)

Numerous organic compounds in the gaseous state have been identified and classified in the air in confined environments:
- VVOC ("Very volatile organic compounds").
- VOC ("Volatile organic compounds in the strictest sense.
- SVOC ("Semivolatile organic compounds).
- POM (Particulate organic matter").

The class of each VOC is particularly important. They are classed as organic compounds that have boiling points between lower than 50-100 °C and higher than 240-260 °C.
Aliphatic hydrocarbons, aromatics and chlorinated hydrocarbons, aldehydes, terpenes, alcohols, esters and ketones are all in this class.
VOCs can cause sensory disturbances and seriously damage one's health. At high concentrations, some VOCs can affect the Central Nervous System (in general however, such effects are encountered at concentrations that are well above those found in confined environments). Some VOCs are known carcinogens (e.g. benzene).
Sources of VOCs include cigarette smoke, building materials, items of furniture, carpets and coverings that can constantly release emissions over a period of weeks or months. Again, the use of printers or photocopiers (especially as they are warming up) or the use of cleaning materials , glues, adhesives and solvents can increase the concentration of VOCs in the air.

BIOLOGICAL CONTAMINANTS

These are airborne organic particles that consist of micro-organisms (both living and dead), pollens, spores, acari (mites and ticks) etc…
The main sources of microbiological pollution in indoor settings include the presence of human beings, stagnant water, textiles, foods, plants and waste materials.
Other sources can include dehumidifiers or air-conditioners followed by the proliferation of micro-organisms in appliances that are improperly cleaned (Legionella, Actinomyces…).
Some especially sensitive individuals may suffer allergic reactions caused by moulds, fungal spores, amoebae, algae, bacteria, acari faeces and derivatives, insects and parasites, pollens, endotoxins etc…

The best way to keep the air clean is to identify the sources of pollution and completely remove them although unfortunately, this is not always possible or feasible.
Good ventilation is therefore often the only remedy.

VENTILATION

THE EFFICIENCY OF VENTILATION

Ventilation is not always applied properly and this can mean that while two rooms may have the same rate of air flow, one may be better ventilated than the other and thus has better quality air.
The efficiency of ventilation is defined as the capacity of a ventilation system to remove pollutants from a confined environment. A highly efficient system can therefore provide excellent air quality with a lower rate of air flow than a less efficient system.
The efficiency of ventilation depends on certain factors such as:
- the characteristics of the system
- the characteristics and position of the air outlets
- the type of room

It is quantified in a non-dimensional parameter: values of less than 1 indicate the possible formation of "bubbles" of air in the ventilated where air is changed less often than the design parameters intended.
The higher the value, the more efficient the system. In addition, an efficient system guarantees an even mixture of air in the whole ventilated area (with the exception of air displacement systems).
Where special turbulence diffusers are used the efficiency value can exceed 1. This means that the system is particularly efficient and that the overall air flow can be decreased while still ensuring an excellent exchange of air and it also prevents the wasteful over-sizing of ventilation systems.
Below are some conventional values for ventilation efficiency according to ASHRAE STANDARD 62.1-2004:
Ventilation systems can be split into two categories:
1.Domestic ventilation systems
2.Industrial ventilation systems.
The key factor however is always the flow rate, i.e. the amount of air to be extracted from or introduced to a room over a given period of time. This rate is usually expressed in m^3/h or m^3/s or l/s.
The choice of ventilator should be based on:
- the type of room: domestic, commercial, industrial
- the volume of the room
- the type of air flow to be ducted and its characteristics
  - clean air
  - air + dust
  - ducting special air-flows
- type of possible ventilation system configuration
  - wall-mounted system with ducted extraction
  - wall-mounted system with direct extraction to exterior
  - window mounted extractor
  - specific extractors for long ducting
  - systems for centralised units
- positioning of air inlets and outlets
- special conditions: temperature, humidity
- required air flow and pressure
- noise level
- Type of power supply: single three-phase.

TYPE OF VENTILATION

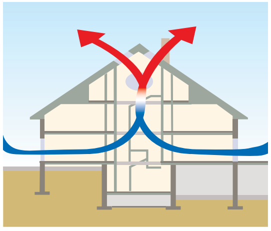
NATURAL VENTILATION

Buildings are naturally ventilated (fig. 3.01) by means of openings in the its shell: chimneys, windows or openings on the roof that utilise the chimney effect, differences in temperature and pressure, differentiated solar energy, the presence of other extractors or ventilation towers…


Fig. 3.01

In old buildings, the gaps around windows and doors provided a certain degree of air exchange. In new buildings however, more efficient windows and doors with tighter seals are fitted to prevent thermal dispersion.

The most widely used approach is simply to open the windows; this has more effect if they are located on opposite sides of the room. Just a few minutes may be enough to ensure good ventilation.

Fig. 3.02


The chimney effect (fig. 3.02) can be taken advantage of for natural ventilation. As long as there is continuous ventilation, all that is needed is to fit an external air inlet to allow the passage of air from one room to another. Air comes in via the inlet and exits through the chimney. Under some conditions, the flow of air might reverse so for that very reason, a ventilator system should be fitted (hybrid ventilation)
In industrial buildings, the exchange of air can be managed by fitting suitable automatically or manually operated extractors on the roof.
In some buildings, ascending columns of hot air can be utilised as a means of continuous ventilation where

APPLICATION	VENTILATION EFFICIENCY
Cold air delivery from above	1.0
Hot air delivery from above with delivery temperature of <8°C compared with room temperature	1.0
Hot air delivery from above with delivery temperature of >8°C compared with room temperature	0.8
Air delivery from below with perfect mixing	1.0
Cold air delivery from below and extraction from above (displacement ventilation)	1.2
Hot air delivery from below and extraction from above	0.7

the flow of air going up runs parallel to the flow going down in the same environment.
As regards air flow rates, energy studies have shown that opening a window equates to an exchange of air of 1.2 vol/h as opposed to the standard values of mechanical systems at 0.5 vol/h or 0.4 vol/h for humidity controlled systems. Natural draught systems equate to 0.8 vol/h whereas poor window fittings allow 0.05 vol/h.

MECHANICAL VENTILATION

In order to provide good control of air flow – something

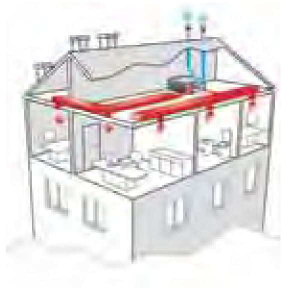


Fig. 3.03

that is lacking in natural ventilation – a mechanical air handling system can be designed to ensure proper ventilation flows.
In such systems, the air flow is provided by one or more fans. There are two systems, those with and those without ducting. The former consist of positioning one or more window or wall-mounted extractor fans. A simple example would be one or more extractor fans and a series of openings that would allow air to flow freely in the room. The positioning and size of the openings must be sufficient to provide the most evenly distributed flow of air possible. These openings can be replaced by delivery fans, usually mounted on the walls opposite the extraction fans. This is a very usual solution in industrial environments.
In some cases the fans cannot be wall-mounted: in this case ducts are used to convey the air to the delivery or return terminals. In residential and commercial environments, ducted systems are preferable as fans can be positioned some distance from the occupants thus eliminating any additional noise.
Mechanical ventilation can be split into single and double flow systems.

SINGLE FLOW: **Extraction**

Systems of this type extract air from the room and convey it to the exterior (generally the roof) via ducting. The extractor is

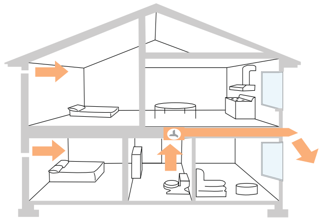


Fig. 3.04

usually positioned some distance from the room it is ventilating.
Air is exchanged by means of vents on the perimeter walls or doors and windows. Sometimes, these vents are positioned behind radiators so that incoming air is warmed slightly before it enters the atmosphere in the room.
If a ventilation system is in fact needed, it is essential that all internal doors are fitted with grilles that allow the passage of air. The size of these grilles must be such that they neither allow excessive loss of thermal energy nor air speeds in excess of 1m/s.

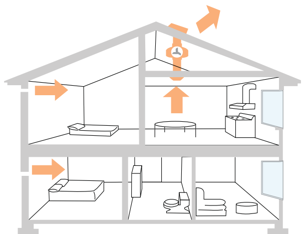


Fig.3.05

In a residential context, extraction is usually used in damp or humid areas (kitchens, bathrooms, laundry rooms, etc.) while fresh air is delivered to living rooms and bedrooms (figs 3.04 and 3.05). In office buildings, fresh air is delivered to the offices, while extraction is done from corridors via ceiling grilles connected by ducting to the exterior; ducts can be led to the roof, which is where the fans themselves are also usually located.

DOUBLE FLOW: **air extraction and delivery**

A double flow system both mechanically extracts air from and delivers it to the room (fig 3.06).
Extraction is the same as for a single flow system.
This term also applies if air is delivered by means of ducting and vents using a separate circuit. The fresh air is “forced” along the ducting by a fan and is distributed into the room with diffusers. The delivery and extraction flows are coordinated by a controller.
In more complex system, the fresh air may be treated before being delivered to the room by filtering, cooling or warming, humidifying or dehumidifying it.
Double flow systems also enable the use of heat exchangers to

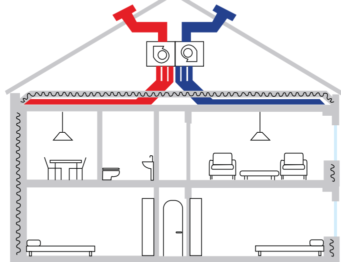


Fig. 3.06

recover thermal energy from the extraction flow.

APPLIANCES FOR VENTILATION

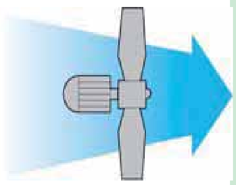


Fig. 3.08

A ventilator or fan is an appliance designed to move air. It consists of a motor (usually electric) that rotates fan blades or a propeller that transfers energy to the air.
The total pressure provided by a ventilator equates to the increase in total pressure of the flow of air created between the intake and outlet sections of the appliance. The total pressure is the sum of the dynamic pressure (tied to the square of air speed) and static pressure (the pressure needed to overcome the resistance offered by the passage of air).
Different types of fans are classified by the type of air flow required and therefore the type of propeller used.

AXIAL FANS

The propeller is made up of a central hub to which the blades are attached. The propeller is housed inside a cylindrical body known as the casing. (fig. 3.09).


Fig. 3.09

The air flows parallel to the rotational axis of the fan meaning that as it passes through the propeller blades, it picks up energy. The flow then continues a straight line but is still revolving due to spin it was given by the movement of the blades.
To limit the spin, a series of counter-rotating propellers can be fitted or the air flow can be directed through vanes that straighten the flow and transform its speed into static pressure.
The performance of an axial fan depends on the blades, the profile of the vanes, the number of blades, their surface area and the angle at which the fan is set.
The casing is often fitted with flanges to allow the fan to be connected to ducting. Such fans are perfectly suited to “in-line” use due to their axial flow characteristics.
In terms of performance, axial fans generally offer good air flow and do not have exceptionally high static pressures. There are various architectural solutions that mean the static pressure can be increased as in using additional fans for example.
Reversing the direction of the blades also reverses the direction of the air flow; this can be of great use under certain conditions where the intake or expulsion of air is needed to improve the air. Generally speaking, reversible fans are designed to optimise air flow in one direction: reversing the direction of the air flow, performance suffers and capacity drops.
These fans are best used in industrial and residential settings.
These fans are ideal for dealing with special extraction requirements: carrying air contaminated with corrosive particles, especially at high temperature (with split flow), operating in potentially explosive areas (with spark resistant motor, propeller and blades) etc…

HELICAL FANS

These are similar to axial fans but have an axial flow propeller.
The difference between helical and an axial fan lies in the fact that the former does not have a casing as this is often replaced by a vent (fig. 3.10).


Fig. 3.10

These fans offer good air flow performance but their static pressure characteristics are somewhat limited.
They are generally used without ducting (as free outlets) or with very limited range ducting.
When operating as free outlets, air from all directions passes through the propeller then continues in an almost axial direction.
Like their axial counterparts, helical fans too are available as reversible units.
They are used in industrial (industrial warehouses), commercial (ventilating greenhouses, barns etc…) or residential settings (extracting air from bathrooms).

CENTRIFUGAL FANS

A centrifugal fan is made up of a certain number of blades positioned along the flaps of a cylinder that rotates along its own axis. Apart from the propeller, the other components of a fan are the cochlea, a spiral shaped casing inside which the propeller and motor rotate (fig. 3.11).


Fig. 3.11

The cochlea features an air inlet lined up with the propeller.
Once in motion, due to the aerodynamic forces in play, the propeller sucks air into the inlet and conducts it radially. The cochlea carries the air through an outlet with an almost straight flow pattern.
The air flow therefore undergoes a change of direction of 90° between intake and outlet.
Single intake ventilation systems (i.e. with just one intake vent) or double intake systems can be made (in this case the intake vents are positioned facing each other in relation to the bases of the cylinder that forms the propeller housing).
There are two types of blades that differ by their shapes:
- straight radial blades
- forward facing blades (i.e. with the curves of the blades matching the direction of rotation)
- backward facing curved blades (i.e. with the curve of the blades going against the direction of rotation)

Fans with straight radial blades generally have modest performance characteristics.
Centrifugal fans are used for dealing with especially “dirty” air as their design does not allow dirt to accumulate on the propeller and, for this reason, they are are often known as self-cleaning fans.
Fans with forward facing blades offer better air flow performance characteristics than other centrifugal fans.
Fans with backward facing blades offer very high performance.
Generally speaking, compared with axial and helical fans, centrifugal fans with the same air flow capacity develop greater static pressure and this makes them ideal for systems using air ducting.
Unlike axial fans, centrifugal units are not reversible; i.e. reversing the direction of the fan does not reverse the air flow.

MIXED FLOW FANS

As the name suggests, mixed flow (or axial impulse) fans combine the characteristics of an axial fan with those of a centrifugal unit even though they physically resemble conventional axial units.
The blades are attached to a conical hub. Air enters the fan along the axis of the propeller and is generally expelled at an angle of between 30° and 50° of that axis.
The housing features special deflectors that direct the flow of air axially and is usually shaped to convert kinetic energy to useful static pressure.
In terms of performance, mixed flow fans provide better static pressure than axial units and can reach similar performance levels to fans with backward facing blades while having the advantage of being less bulky.

DOMESTIC FANS

These are low capacity fans suited too extracting stale air from rooms (fig. 3.15).

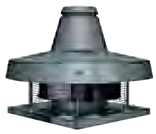
Fig. 3.15

They take the air directly from their surrounding environment and transfer it directly or indirectly (using ducting) to the outside. Some helical fans are suitable for both direct extraction to the outside or can use limited length ducting, as are some centrifugal fans that can carry air along longer ducting systems.
These are often used as bathroom air extraction systems.
They can be fitted with automatic start/stop systems (where they start if a preset humidity or air pollution threshold is passed, or can feature proximity sensors etc).

TOWERS

Ventilation towers extract air via the roof (fig. 3.16). They are specially designed for external applications.

Fig. 3.16



Towers can be installed as free-standing units to extract air directly from an area and expel it to the outside either radially or vertically depending on the type of unit.
The propeller is often centrifugal with radial expulsion but there are also axial propeller towers (that also allow flow reverse and thus a fresh air delivery) and mixed flow towers. In the version with a centrifugal propeller or mixed flow system, the tower can be connected to ducting for extraction purposes.

IN-LINE

In-line fans are specially designed to be positioned in an air ducting system (fig. 3.17).

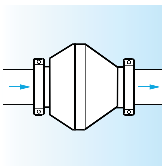


Fig. 3.17

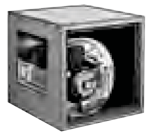
They can be centrifugal, axial or mixed flow.
With identical air flow capacity and intake and outlet sizes, the centrifugal version provides the best static pressure followed by the mixed flow and axial unit versions.
The axial unit is the least bulky system followed by the mixed flow system and the centrifugal system.
The centrifugal system is also noisier.

In-line fans can be easily installed anywhere along ducting and for this reason are very often used in industrial plants.

BOX FANS

These fans are positioned inside special housings (usually cube-shaped) that apart from helping prevent accidents and protecting the fan from the elements, have acoustic insulation to suppress noise from the unit and act as a chamber for the fans inside it.

Fig. 3.18



The most commonly seen units have centrifugal fans and cochleas but there are others with centrifugal or mixed flow systems: in such case, the inside of the housing is specially shaped to allow air to be directed and some of the kinetic energy to be transformed into static pressure.

HEAT RECOVERY SYSTEMS

A heat recovery unit is a double flow ventilation system that both delivers air into an environment and treats "clean" air while at the same time extracting stale air to the outside. The two flows of air exchange heat inside the unit (or better still, inside the heart of the unit i.e. the heat exchanger) in such a way that the hotter of the flows loses some of its heat to the colder flow (fig. 4.03).
In a typical configuration, the heat recovery unit is not a heat generator nor a chiller, so it must be used in combination with a normal heating or A/C system.
The machine has the following main components:

Housing - as well as containing various unit components, the housing insulates it acoustically: it can be made from galvanized sheeting, plastic film-coating sheet or plastic single or double panels. It can also be fitted with acoustic insulation to reduce running noise.
Fans - drive the air and each unit includes a delivery fan (delivers air from outdoors to the interior) and an extraction fan (from the interior to outdoors).
Heat exchanger - the heart of the recovery system. This is where heat transfers between the inlet and outlet air flow systems.
Filters - the machine is usually fitted with filters that protect the motors from dust but also serve to filter both extracted and delivered air.

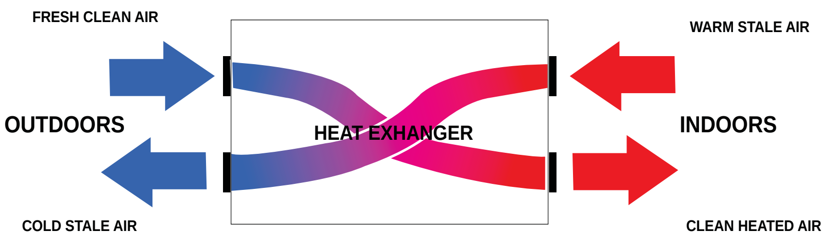
CLASSIFICATION of heat exchangers:
Heat exchangers can be classified according to different criteria.
One of the main criteria concerns RECOVERY MODE.
There are two distinct modes:

STATIC RECOVERY SYSTEMS
DYNAMIC RECOVERY SYSTEMS

STATIC RECOVERY SYSTEMS

In these systems, the exchange of heat takes place between the two flows of air that are in contact with a wall that separates them from each other in the heat exchanger. These flows never actually come into contact with each

Fig. 4.03



flows never actually come into contact with each other. Examples of static heat exchangers include those with heat plates, those coupled to cooler batteries and tube heat exchangers … (fig. 4.04).


Fig. 4.04

DYNAMIC RECOVERY SYSTEMS

In these recovery systems, the two flows of air come into contact alternatively with heat recovery element. This element transfers heat from one flow to the other by taking heat from the hotter of the flows and cooling itself from the colder flow. Examples of dynamic recovery systems include rotary heat exchangers, enthalpy wheels … (fig. 4.05).

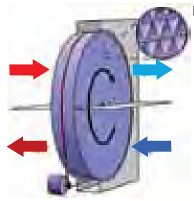


Fig. 4.05

A additional classification criterion is based on the TYPE OF RECOVERY, i.e. if the recovery is only from heat sensitive components or if latent heat is also recovered.
In this case we have:

SENSITIVE RECOVERY SYSTEMS (recovery from only heat sensitive components only)
ENTHALPIC OR TOTAL HEAT RECOVERY SYSTEMS (where latent heat is also recovered)

HEAT SENSITIVE SYSTEMS:
In these recovery systems, neither of the flows of air comes into contact with each other. The exchange of heat only occurs due to the difference in temperature of the flows that are in contact with the dividing wall in the exchanger. Examples of this type of system are exchangers with metal or PVC cross-flow or counter-current packs or with rotary aluminium packs (fig. 4.06)

TOTAL RECOVERY SYSTEMS

In total recovery (or enthalpic) systems, the heat exchanger can also transfer latent heat from one flow to the other by condensation.
This happens thanks to the special material the exchanger is made of. This component is made from: a specially impregnated cardboard or metal that has been machined to provide a corrugated surface,


Fig. 4.07

polymeric materials, silica gel, zeolite and aluminium (fig. 4.07).

ADVANTAGES OF HEAT RECOVERY UNITS

• They are double flow units and so renew the air in rooms.
- Thanks to the machine's filters, pollution can be kept under control.
• They pre-heat or pre-chill the fresh air by recovering energy at zero cost from the extraction flow. This energy would otherwise be lost in a ventilation system not fitted with heat recovery (resulting in higher running costs and harm to the environment).
• Energy recovery makes it possible to use smaller heating and A/C units (boilers, air conditioners, roof-top units, water chillers, etc.)
• They reduce wear and tear on heating/cooling system equipment.
• Over time, the initial investment is paid back by the savings in overall running costs.


Fig. 4.06

VENTILATOR SYSTEM APPLICATIONS

Choosing the right type of propeller is the key to meeting your ventilation requirements. Each model has its own strengths and weaknesses and might therefore suit one set of circumstances and not another. Other parameters that need to be considered include the type of air to be treated and the setting in which the system will be used.

SPECIAL APPLICATIONS

Each of the ventilator system types described above can be used for special applications such as:

• operating at high temperatures or in emergencies like those used to extract fumes in the event of fire. In such case, the motor must not be enveloped by the air flow (such as in the case of axially split fans or belt driven centrifugal fans). For very high temperatures, special steel manufacturing materials are needed.

• carrying high corrosive content air flows. The parts that are in contact with the corrosive materials must be protected with films, protective paint or special treatments. Fans used in acidic environments are often made of plastic components.

• operating in potentially explosive environments. Such fans are known as explosion proof and are made of special materials manufactured to very small engineering tolerances so as not to create sparks when in use. Other special applications may call for improved resistance to the elements (rain, damp, sunlight), for carrying air containing abrasive dust or for preventing the formation of moulds or other.

CHOOSING A VENTILATOR SYSTEM

To choose the right fan for use with ducting, you need to establish two fundamental facts:

- the air flow needed
- the pressure that the fan needs to develop in order to overcome the air pressure in the environment.

Once you have established the air flow and the intended use, you have to calculate the pressure drop that will occur in ducting or more generally, the pressure drop that will take place once the air is delivered.
These drops depend on the air flow characteristics of the fan, whether the fan is fitted or not with filters and shutters and the diameter and length of the ducting.
Let's examine a few of the terms in normal use in this field.

AIR FLOW

This is the amount of air that a fan can displace in a given period of time.
It is expressed in m^3/h or l/s.
A m^3 is equivalent to 1,000 litres.

DYNAMIC PRESSURE

Air, just like a fluid in motion, exercises a certain pressure against obstacles it encounters on its way. This explains the pressure you feel when you put your hand in front of a fan. As you increase the speed at which the fan rotates, so too you increase the air flow and therefore feel stronger pressure against your hand.
Dynamic pressure is directly linked to the movement of air and is mathematically defined as:
$PD = ½ \rho v^2$
Where:
PD is the dynamic pressure (Pa)
ρ is the density of the air (1.225 kg/m^3 in standard conditions at sea level)
v is the velocity of the air (m/s).

STATIC PRESSURE

This is the pressure that opposes the movement of air and is caused by friction or by the presence of obstacles in ducting.
It is defined as:
$PS = P0 – PA$
Where:
PS is the static pressure (Pa)
P0 is the absolute pressure at the point examined (Pa)
PA is barometric atmospheric pressure (Pa).

Let's take for example a length of large diameter ducting along which air can flow freely; if we add a diaphragm we decrease the bore of the ducting and thus increase the resistance. The flow therefore also decreases and we create pressure behind the diaphragm inside the duct. This pressure is not linked to the speed of the air and is therefore called static pressure.

TOTAL PRESSURE

This is the pressure a fan generates to move air and to overcome resistance opposed to its motion.
PT = PS + PD (Pa)
This pressure is measured in mm WC or in Pa; 1 mm WC equates to 9.81 Pa.

POLES/RPM

The more poles a motor has, the higher or lower the rpm attainable. The lower the number, the higher the rpm corresponding to higher flow and pressure but also to more noise.

INSULATION CLASSES

This is the degree of protection afforded against electrical shocks through the casing is split into two classes:
Class I products where electrical components can be easily touched.
Class II covers products where electrical components are impossible to touch and these products need not be earthed.

MECHANICAL PROTECTION CLASS

This is the degree of protection the housing affords against contact with solid external foreign bodies and against access to dangerous components (1st letter); The 2nd letter indicates the degree of protection against the penetration of liquids. The higher the letters, the better the protection.

Lp dB(A) 1m

Indicates the noise level generated by mechanical vibration and varies in line with the distance between the source and user. Doubling the distance, the Lp values decrease by 6 dB.

Lw dB(A)

Indicates the amount of energy in wave form that an acoustic source emits every second.

CALCULATING PRESSURE DROPS

To establish the static pressure to be developed by the fan to endure the right air flow, you need to consider all the elements that in the environment that might introduce load losses i.e pressure drops.
Such pressure drops are expressed in the International System in Pa.
The elements to be considered are:

- losses at the system inlet
- losses due to friction in the ducting
- losses caused by changes in cross section
- losses created by changes in direction
- losses caused by the flow being split into different branches
- losses due to obstructions, grilles, diffusers
- losses caused by filters
- losses generated by batteries of heat exchangers
- losses at the system output.

PRESSURE DROPS IN DUCTING

Even a fairly short, similar diameter length of ducting offers resistance to air flow due to friction between the air in motion and the inner walls of the ducting.
Pressure drops are greater at higher air speeds (proportional to the square of the speed) and the same applies to the roughness of the walls.
Given that volumetric flow and velocity are connected by the equation:
$v = Q / A$
where:
v = mean velocity in the ducting (m/s)
Q = air flow (m^3/s)
A = ducting cross section (m^2)
we see that with the same air flow, pressure drops increase with a decrease in cross section and by halving the cross section we increase these drops by a factor of four.
To allow for the differing roughnesses of ducting walls, we introduce the multiplying factor K. The higher this figure, the rougher the walls.
Pressure drops in the case of a short straight length of ducting are therefore:
$\Delta P = K * ½ \rho v^2 = K * ½ \rho (Q/A)^2$
where ρ is the mean density of the air and v its mean velocity.
For round ducting of length L and diameter D, we can consider:
$K = f * (L/D)$
For rectangular ducting of length L and cross section a x b, we have:
$K = f * (L/D)$
$Dh = 2*(a*b) / (a+b)$ = hydraulic diameter.
f represents friction. This varies in line with the properties of the air, its speed, the dimensions

VORTICE

of the ducting and the actual roughness of the walls.
Below are several examples of the coefficient of correction K of pressure drops experienced with differing ducting manufacturing materials.

Type of ducting	Coefficient of correction K
Zinc-plated sheet metal with joints at every 1.2 metres	1.0
Zinc-plated sheet metal with very precise machining	0.90
Zinc-plated sheet metal with no joints	0.95
Aluminium	0.90
Smooth wood or masonite	1.30
Eternit	1.50
Smooth lining	1.55
Plaster	1.75

ACCIDENTAL PRESSURE DROPS

Calculating accidental pressure drops caused by changes in ducting cross section, by forks and by the ducting inlets and outlets is performed using the dynamic pressure loss factor K:
$\Delta P = K * \frac{1}{2} \rho v^2$.

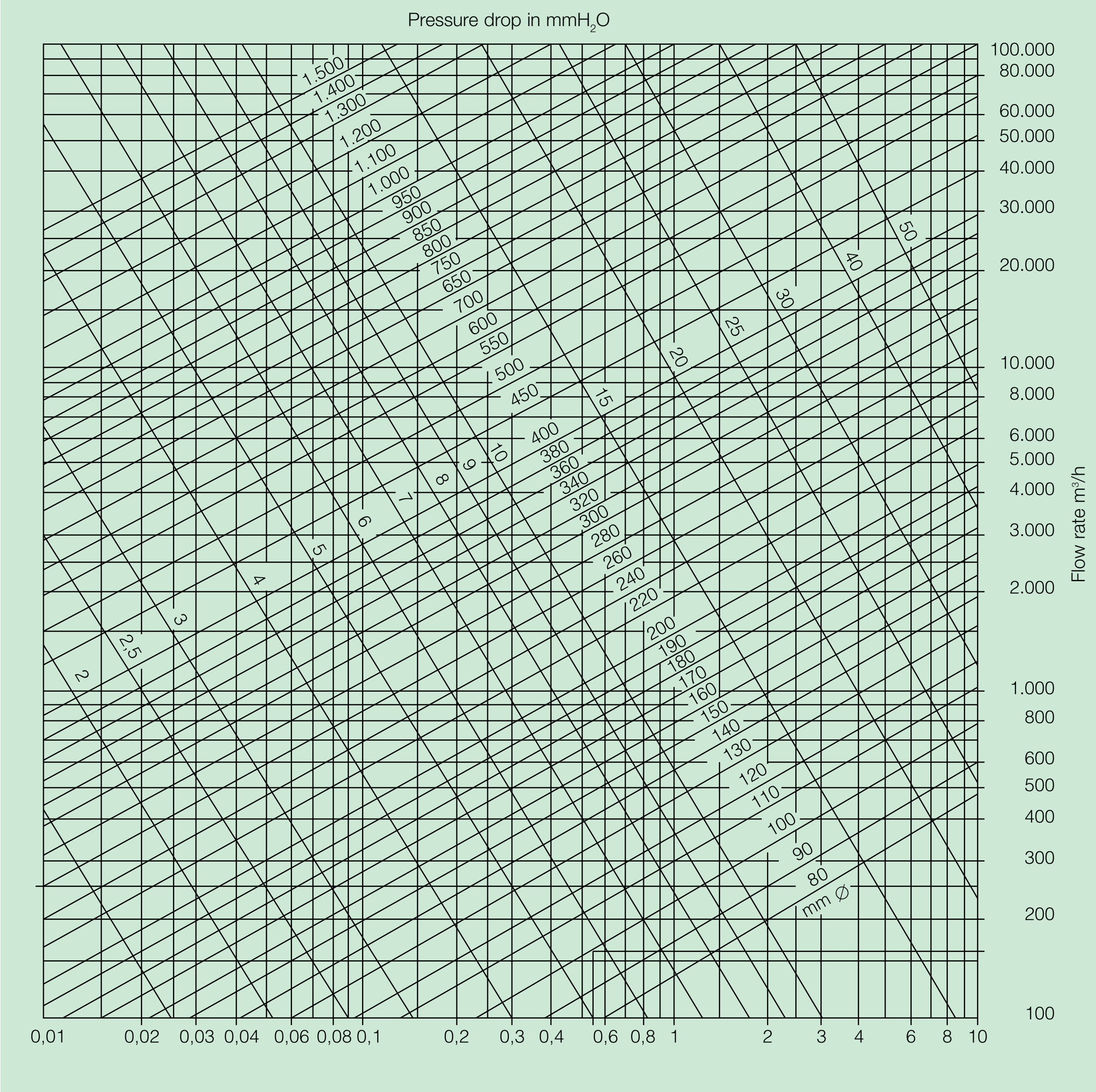
Type	Coefficient of correction K	Notes
Inlet in tabulation	From 0.10 to 1.25	Lower values for inlets with taper, lower for inlets without taper
Ducting outlet	1.00	
90° bends on straight segments in round or rectangular ducting	From 0.20 to 1.30	K decreases with an increase in the number of segments and with an increase of the ratio between the radius of the curvature and diameter (hydraulic) of ducting
90° bends in round or rectangular ducting	From 0.10 to 1.00	K decreases with an increase of the ratio between the radius of the curvature and diameter (hydraulic) of ducting
90° joint in rectangular ducting with internal deflector flap	From 0.80 to 1.40	Values of K are low for R/W values of 0.5 (R=deflector radius curvature, W=width of ducting)
90° bends in round ducting with internal deflector flaps	0.3	
90° joint in round ducting with internal deflector flaps	From 0.10 to 0.50	K decreases with an increase in the radius of curvature
45° bends	From 0.10 to 0.70	
T joint	1.40	K varies depending on flow distribution
Y joint	From 0.10 to 1.00	K varies depending on flow distribution and on the angle between the inlet and outlet
Decrease in cross section with diffuser (diffuser angle between 15 and 45°)	0.10	
Increase in cross section with diffuser (up to 45°)	From 0.15 to 0.90	Higher values for bigger angles
Decrease in cross section without diffuser	From 0.10 to 0.45	Depends on cross section surface area ratio

In general, pressure drops are greater where there are sudden changes in cross section or in direction. To obtain better (lower) K values and thus lower pressure drops, it is best to design the layout of ducting with gentle bends and minor changes in cross section. The use of deflector flaps in bends greatly reduces drops in pressure. Given the direct proportionality to dynamic pressure and therefore to the square of the mean velocity of the air, the use of larger cross section significantly decreases drops in pressure.

POWER DROPS IN SYSTEM COMPONENTS

Other components that create resistance in the system itself include filters, batteries of heat exchangers and air distribution units.
The drops in pressure caused by these components are declared by manufacturers.
It is not enough to know just the pressure drop caused by a clean filter; during use the size of the drop increases as the flow of air becomes partially blocked by impurities trapped by the filter. Filter manufacturers recommend a pressure drop limit beyond which the filter should cleaned or changed.

PRESSURE DROP DIAGRAM



FOR USE INSIDE DUCTING

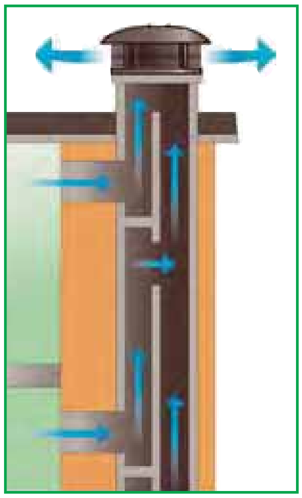
For ducted ventilation, we have CA V0 axial centrifugal extractors that are made of self-extinguishing spray-proof V0 plastic.

FOR DIRECT EXTRACTION TO THE OUTSIDE THROUGH WINDOWS/WALLS

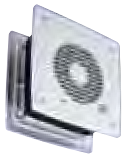
We have a complete range of wall and window mounted helical extractor fans for medium and large domestic and commercial settings. These units have automatic cut out systems and expel stale air directly to the outside.
Reverse mode models are also available.

VENTILATE THE WHOLE HOUSE WITH JUST ONE EXTRACTOR

Roof-mounted tower ventilator systems offer a wide range of solutions. These are fitted to the top of communal extraction chimneys and are specially designed for continuous operation. They can radically resolve ventilation problems as the air in each toilet normally fitted with a grille is extracted as and when necessary.



FOR WALL-MOUNTIN GAND DIRECT EXTRACTION TO THE OUTSIDE

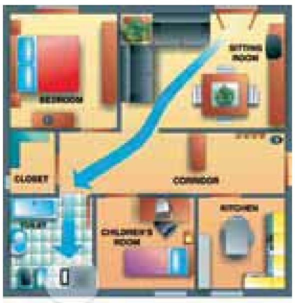


We have 3 helical extractor models for flush wall fitting with automatic cut out systems.

FOR DIRECT EXTRACTION TO THE OUTSIDE THROUGH WALLS, WINDOWS AND THE CEILING.

A complete range of helical fans to ventilate small or medium sized rooms in intermittent or continuous mode. Can be supplied with or without automatic cut off, timer, pull cord, humidity switch and proximity sensor.

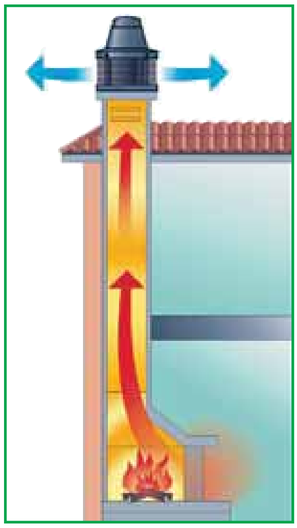
FOR DUCTED EXTRACTION



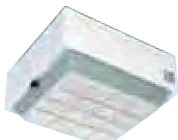
A complete range of centrifugal ducting extractors for wall ceiling/false ceiling and partition wall mounting for intermittent/ continuous operation for small or medium sized domestic or commercial settings. Available with or without timer, humidity switch and electronic microprocessor.

FOR SMOKE CHIMNEYS

The "Tiracamino" is a radial extractor fan for chimney tops designed to draw out smoke from a fireplace. But it's more than just that. With a "Tiracamino" you can enjoy having the fire lit without any fear of smoke coming back into the room and if the fire isn't lit, you can use it as a ventilation system.



FOR USE IN KITCHENS



For use in emergencies or for extracting fumes and smoke from kitchens, we have two series of extractor hoods (Vortice free-standing hoods and Vortex cooker hoods). We also have an under-hood centrifugal extractor and all these models are for use with ducting.

PRACTICAL GUIDE TO ESTIMATING AIR CONDITIONER SIZES

The table alongside will give you practical guidance about how to calculate the rate of heat extraction needed to condition an area and help you choose the most suitable appliance. This method is generic by nature and provides reliable results but the data must be certified by a qualified technician.

Notes

- This calculation presumes that there are no significant sources of heat in other areas that are above or below the area to be conditioned.
- Conditioner units mounted in the shade perform better.
- The table refers to standard domestic use with maximum external temperatures of 35°C and relative humidity readings of 50%.
- The air conditioner chosen in accordance with the calculation performed using this table will allow the temperature inside the area to be lowered to about 6°C below the temperature outside.
- The calculation will provide the rate of heat extraction in BTU/h. To change BTU/h into different units of measurement, use the following coefficients:

from BTU/h to W = multiply by 0.293
from BTU/h to Kcal/h = multiply by 0.252.

Electrical appliances present	W........	x 3.4 = BTU/h	....
....	W........	x 3.4 = BTU/h	....
Occupants			
persons doing normal activities	N°........	x 200 = BTU/h	....
persons doing moderate activities	N°........	x 350 = BTU/h	....
persons doing heavy activities	N°........	x 600 = BTU/h	....
Floors	m²........	x 25 = BTU/h	....
Windows			
facing north	m²........	x 150 = BTU/h	....
facing south	m²........	x 400 = BTU/h	....
facing east	m²........	x 300 = BTU/h	....
facing west	m²........	x 500 = BTU/h	....
Ceilings			
with rooms overhead	m²........	x 30 = BTU/h	....
with insulated roof	m²........	x 140 = BTU/h	....
with uninsulated roof	m²........	x 200 = BTU/h	....
Outer walls			
facing north	m²........	x 20 = BTU/h	....
facing south	m²........	x 60 = BTU/h	....
facing east	m²........	x 55 = BTU/h	....
facing west	m²........	x 65 = BTU/h	....
Inner walls........	m²........	x 20 = BTU/h	....
Air entering the building (public places)..	N° pers./h	x 120 = BTU/h	....
Air exchange........	mc/h........	x 8 = BTU/h	....
	TOTAL	**BTU/h**	

AIR CONDITIONING + FAN = REAL WELL-BEING

We feel better if we are surrounded by a current of fresh air.
The slight breeze generated by a ceiling mounted fan at low speed goes unnoticed but provides a sensation of great comfort and makes us feel much more at ease and significantly increases our sense of well-being.
There is also less need to decrease the temperature and energy is therefore saved
The cool air generated by air conditioning falls to the floor (legs much colder than the face) and is evenly spread throughout the area by the fan to create the ideal environment with no sudden jumps in temperature (fig. 13).

COMFORT TOO IN PLACES FAR FROM THE AIR CONDITIONER

Air tends to concentrate in the areas nearest air conditioner units. Large or unusually shaped areas (e.g. L-shaped rooms) will have zones that are distinctly hotter of colder than others.
A well positioned directional fan (e.g. an Ariante Tower) can very effectively provide cool air throughout the environment (fig. 14).

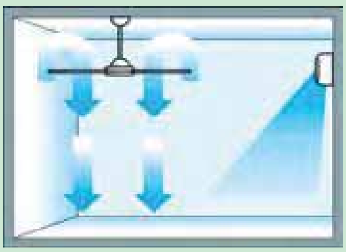


fig. 13

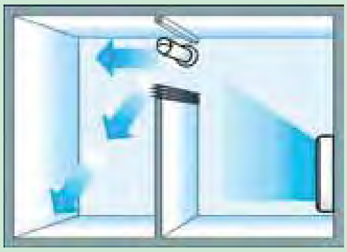


fig. 14

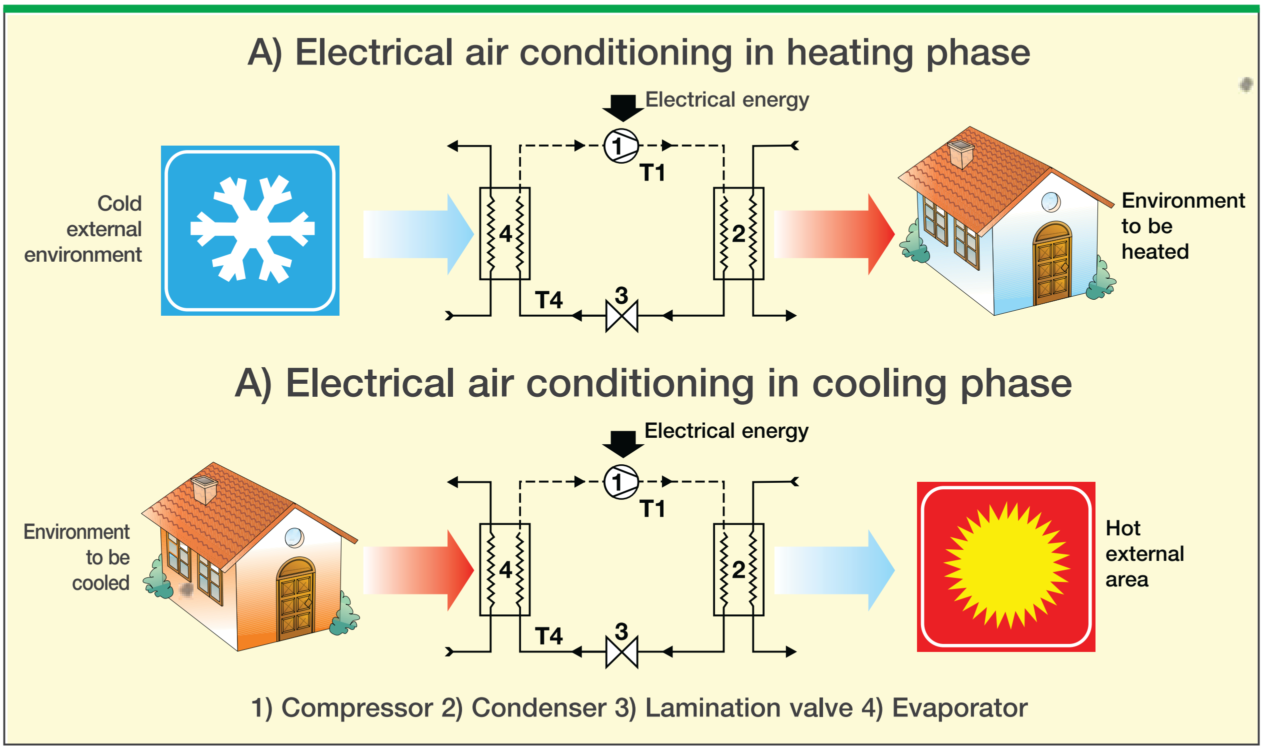
HOW A HEAT PUMP AIR CONDITIONER WORKS

Heat pump air conditioners offer much better heating performance than conventional heating systems (gas or electric boilers or heaters).
In apartment blocks with one central heating system, heat pump air conditioners can be used for mid-season heating (before the central heating system has been turned on), or during the times when use of the central heating system is not allowed to be used. This means that you can enjoy a warm environment whenever you want.
As can be seen in chart A, the coolant that normally flows in a liquid state inside the sealed circuit before the lamination valve (3), cools due to the narrowing of the next section it must pass through. At this stage, the temperature of the coolant is lower than that outside (even on a cold day). The fluid evaporates in the heat exchanger/ evaporator in the outer unit (4) and absorbs heat from the surrounding atmosphere. Now is gaseous form, it passes through the compressor (1) and heats up to a temperature, T1, that in higher than the that of the room to be heated.
On completion of its journey around the system, the heated fluid passes through the heat exchanger/ condenser in the inner unit where it loses its heat to the atmosphere.
When the system both absorbs heat from the outside and loses it to the inside, fans on the inner and outer units play an active role.

WHAT IS THE OUTPUT?

Based on what has already been said about how air conditioning works for heating purposes, the use of this appliance means that "useful" thermal energy is always greater than that absorbed from the power supply. In other words, the area to be heated is supplied with the same amount of thermal energy that it takes from the outside (free of charge) plus the electricity needed to operate the compressor.
The conditioner's coefficient of performance (COP) is calculated as follows:
Under normal operating conditions, this ratio is always higher than 1.
The higher the COP, the better the economic benefit. This value is not constant and varies in line with the external air temperature: the higher the temperature, the higher the COP, the lower the temperature, the lower the COP.
In general, for an air conditioner to perform well as a heater, the external temperature should not go below 6-7°C. Bearing this in mind appliances currently on the market have an average COP value of between 2.5 and 3.5. These values vary greatly depending on the climatic area
where the unit operates: it will be higher in southern Italy and the islands and lower in the north of the country.

$$COP = \frac{\textbf{thermal energy from the environment}}{\textbf{electrical energy consumed by the appliance}}$$



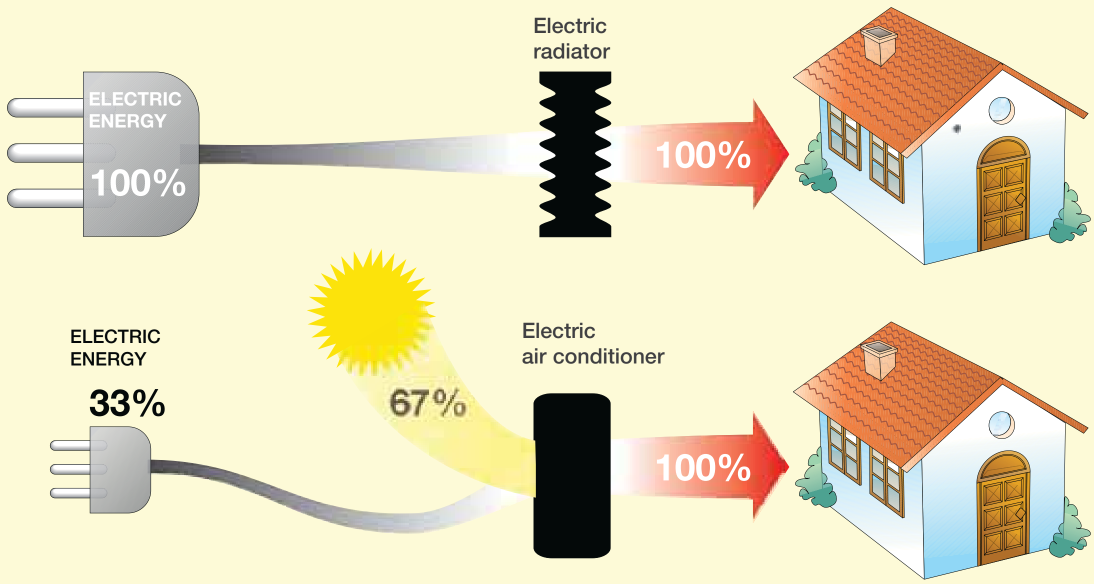
IS IT CONVENIENT?

If we use an electric heater, an oil-filled radiator or a fan heater, we have to draw the exact amount of energy we need to provide heat from the mains e.g. 2000 W. We can however get the same result using a heat pump air conditioner. Let's say that the conditioner has a COP value of 3, to obtain the same amount of heat, it needs only draw 33% from the mains and the remaining 67% comes directly from the external atmosphere. This means that for the same heat yield, we can save up to 67% over a traditional system.

EXAMPLES

In houses under construction or undergoing complete refurbishment, the installation of a heat pump air conditioner may well prove to be a great investment. This means instructing your installer to prepare the building for such an unit that can either be installed immediately or at a later date.
As a rule of thumb, a typical 3 kW electrical supply system is sufficient to meet the heating and cooling requirements of an apartment with the following characteristics.
1. it is in an apartment block on an intermediary floor in an area that is at seal level;
2. it has a surface area of no more than 80 m^2 and is located in a part of northern Italy exposed to the west;
– or the surface area is more than 100 m^2 and it is located in a part of central Italy exposed to the east or west;
– or the surface area is more than 120 m^2 and it is located in a part of southern Italy or the islands exposed to the north, east or west.
As you can see, the climatic conditions where the unit is installed, play a significant role and can affect the type of installation and product to be used.
In addition, owners of apartments who have a 3 kW contract, can ask their electricity supplier (e.g. ENEL ...) for a dedicated supply for a heat pump air conditioner and then enjoy even more benefits.

Comparison between a heating system using electric radiators and a system heating using reversible electric air conditioning



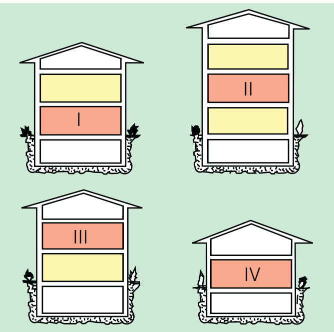
A GUIDE TO SIZING ELECTRICAL HEATING

How to choose the right sized heating system

The information provided only applied to modern buildings with outer walls made from 26 cm hollow bricks with a 2 cm layer of plaster on both the inner and outer surfaces for a total thickness of 30 cm, outer walls with windows taking up approximately 10% of the wall surface area, single glazed 4-5 mm windows with wooden frames, horizontal floor beams marking out rooms in 18 cm hollow brick, air exchange 50% of volume of room.

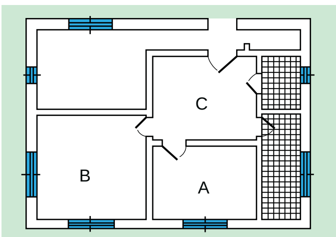
Determine the position of the dwelling in the building

I) above an unheated cellar, below a heated floor
II) between two heated floors
III) below an unheated attic, above a heated floor
IV) single floor situated above an unheated cellar, below an unheated attic.



Determine the position of the apartment in the dwelling

A. apartment with one external wall
B. apartment with two external walls
C. apartment with no external walls.



Identify the minimum external temperature in the area

To choose the right size of heating system, it is vital to determine the minimum temperature that the area in question reaches in the coldest part of the year.

Determine the difference between the desired internal temperature and the external temperature

Once you have established the desired temperature, calculate the difference with the external temperature (e.g.: Desired ind oor temperature = 18°
Minimum external temperature = – 3°
(+18°) – (–3°) = 21°: difference between desired internal temperature and minimum external temperature).
Add – 0.5°C for every 100 metres the house is above sea level.

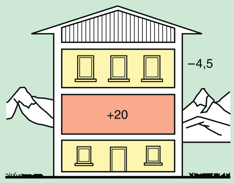
Perform the calculation as follows

We now have the data needed to perform the calculation. Enter the difference between desired internal temperature and minimum external temperature in column D in the chart alongside. Enter the type of position of the dwelling and apartment in column F or G.
N.B.: use column F when you want the heating system to operate in continuous mode. Use column G for use of 6 hours per day.
Draw a straight line between the points marked in columns D and F or G to find the value of Watts per cubic metre in column E. Now multiply the W/cubic metre figure by the number of cubic metres of the area to be heated to find the total power requirement.
You won't need a calculator for the multiplication if you do as follows. Enter the number of cubic metres of the area to be heated in column L (side x side x height); draw a line between the point in column E and the one in column L to find the total amount of Watts you will need to heat the apartment in column H.
If the apartment is exposed to the north add 10%.

Practical example

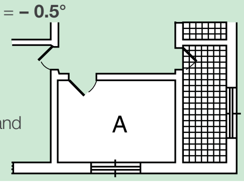
Apartment on second floor between two heated floors:
Case II

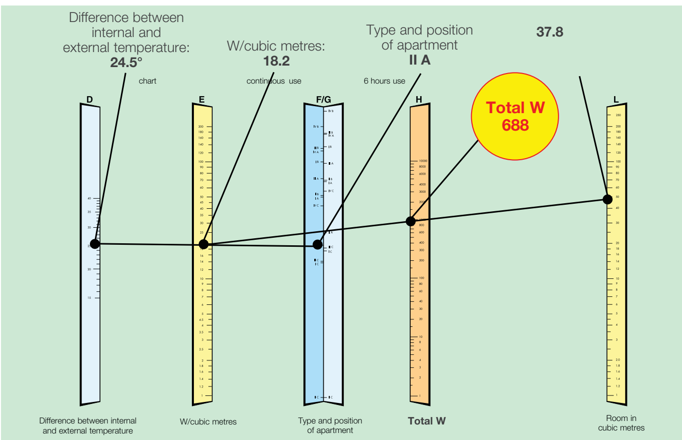
Room in cubic metres
side · side· height
4 · 3.5 · 2.7 = **37.8** m³

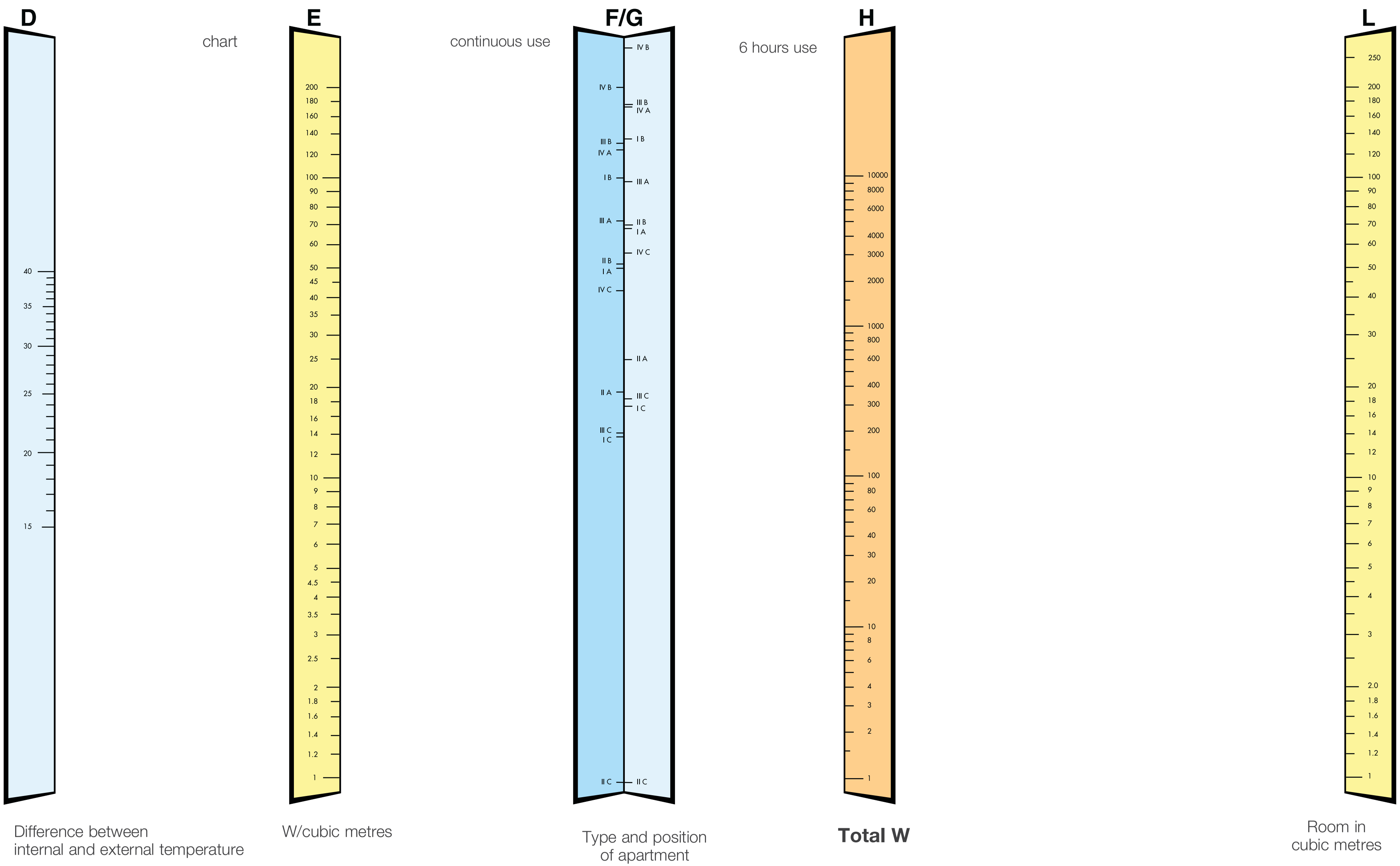


Apartment with one external wall:
Case A

Location:
SALÒ (BS) external temperature = **– 4°**
100 metres above sea level = **– 0.5°**
(– 4°)+(– 0.5°) = **– 4.5°**
Desired indoor temperature **+20°** (continuous use)
Difference between internal and external temperature
(+20°) – (– 4.5°) = **24.5°**






D
chart
E
continuous use
F/G
6 hours use
H
L
Difference between
internal and external temperature
W/cubic metres
Type and position
of apartment
Total W
Room in
cubic metres

IN ROOMS WITH HIGH CEILINGS, HEAT RISES AND IS LOST RESULTING IN SIGNIFICANT INCREASES IN HEATING COSTS

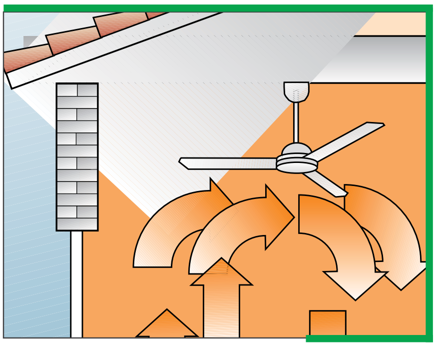
The problem of stratification and heat loss

There are many types of buildings with “high” ceilings. For example we have industrial warehouses, gyms, churches, theatres, garages, hangars, indoor tennis courts, barns, storerooms, libraries, vehicle repair workshops, factories, laboratories etc...
During the winter when these buildings are heated, a very common physical phenomenon occurs: as hot air has a lower specific weight than cold air, it quickly rises and creates layers. The difference between the temperature at the ceiling and the floor can reach as much as 13°C. In addition to this, heat is lost to the outside especially through poorly insulated windows and roofs.
It is safe to say that the higher the ceiling, the more heat you need to put into a room to obtain a comfortable environment.
This means the heating systems in such buildings need to operate continuously and expensively (as the thermostat always detects a lower temperature than that needed). Needless to say, this involves a significant waste of energy and money as well as not providing heat where it is really needed.

IN MANY CASES THE MONEY SPENT ON INSTALLING A VENTILATION SYSTEM IS RECOVERED IN THE FIRST YEAR

Consider the characteristics of the environment to be heated

Fan heaters or hot air generators are usually used to heat large areas and are generally only directed at specific areas in these surroundings. This leads to the creation of areas of significantly different temperatures. A better distribution of heat is obviously required.
These and other factors have to be carefully considered so as to fit a suitable number of ceiling fans.
The result should be an excellent heating system that provides the evenly distributed heat we need to work and live in comfort.
It therefore makes good economic sense to install a Nordik system where the temperature difference between the ceiling and floor exceeds 3°C.

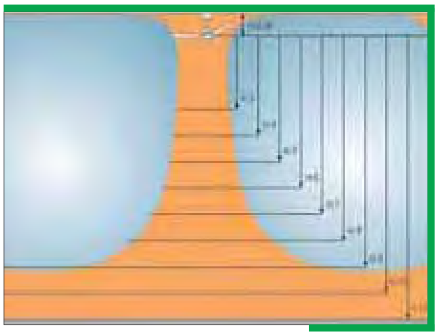


Huge benefits in next to no time

Thanks to its high performance rating, it has been reckoned that the cost of an intelligent Vortice ceiling fan system is often recovered within the first year of installation.
Considering how little time it takes to recover the initial outlay, it makes even more sense.
In addition, a system like this not only recovers heat during the winter but can be used all summer to create the pleasant sense of physical well-being that lets us work and live in a perfect micro-climate. The system can also work in combination with an existing air conditioning unit.

THE EFFICIENCY OF FANS IN RELATION TO THEIR HEIGHT ABOVE THE FLOOR

As can be seen from the table, the greater the distance between the ceiling and floor, the fewer fans needed. This is because the higher the fans are installed, the more efficient they are.



When we lock the doors behind us, we often leave our problems at the door. We feel safe and in a "protected space". This really isn't the case because the true danger is the air we breathe.
There are however solutions for all that call for a modest investment, are extremely positive and, if considered from the cost-benefit point of view, are the natural choices to make.
Air cleaning systems do not "compete" with other ventilation systems and are installed to meet different needs.

WHEN TO CHOOSE AIR CLEANING

- In all surroundings where there are pollens, fumes or dusts that you want removed without changing the temperature or level of humidity;
- in domestic settings, in public places and in work areas where there is a lot of road traffic (traffic pollution can reach as high as the third floor of a building);
- in rooms inhabited by people who suffer from allergies caused by pollens;
- during the summer, in combination with an air conditioning system, to purify the air in purposely closed areas;
- in settings where it is difficult or inappropriate to maintain a hygienically controlled atmosphere: in rooms used for children and babies, the elderly, dental surgeries, clinics, hospitals, etc.

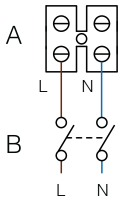
WHEN TO CHOOSE FORCED VENTILATION

- Always in public or private bathrooms without windows as forced ventilation with electric extractors in such rooms is required by Law 166;
- always in toilets and bathrooms in general as, due to their intended use, air needs to be changed quickly and the damp air created by use of baths, showers and wet towels needs to be removed;
- always in kitchens where it is vital to quickly remove fumes, smells and humidity.
Air cleaners are not recommended for use in kitchens as the amount of oil-laden particles in the air can very quickly block the filters.
- in all settings where you need to quickly remove internal pollution and dampness;
- in all settings, be they domestic, public or workplaces, where there is a high level of pollution (tobacco smoke or other) fast recycling of air would protect ones health;
- in all public places, especially bars, restaurants, pizzerias, etc. where the frequent opening and closing of doors would negate the effects of air cleaning and air recycling.

The diagram above shows how the Vortronic system cleans air by passing it through filters.

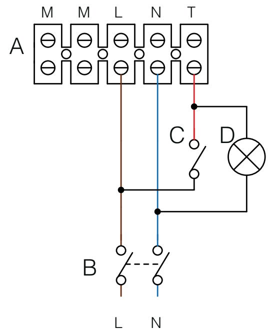
The diagram above shows how extractors work by extracting air from the surroundings and replacing it with with cleaner air.

Punto Ghost Range
Punto Range
Axial K Range
Vort S Range
Ariett Range
Ariett I Range



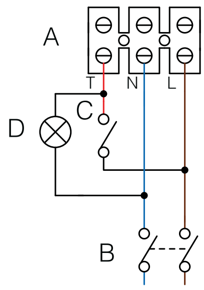
A) Terminal
B) Two-pole switch

Punto T Ghost Range



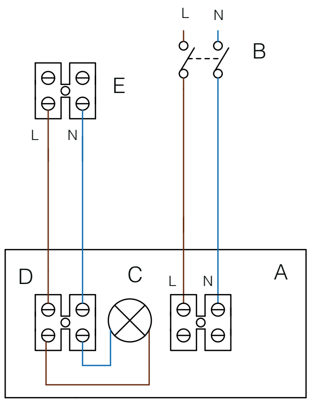
Punto Timer • T HCS

A) Terminal
B) Two-pole switch
C) Light switch
D) Light



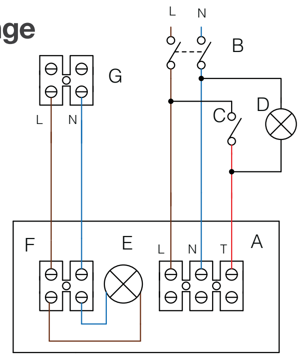
Punto 12V P

A) GA Terminal
B) Two-pole switch
C) Warning light
D) Terminal output 12 V
E) Punto 12 V terminal



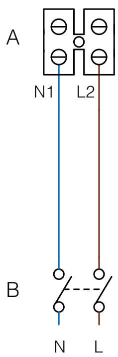
Punto 12V T Range

A) GA Terminal
B) Two-pole switch
C) Warning light
D) Light
E) Indicator light
F) Terminal output 12 V
G) Punto 12 V terminal

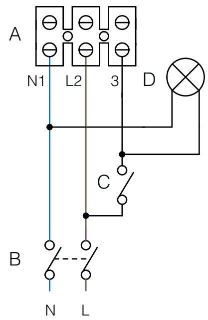


Punto Filo Range
Punto Four Range

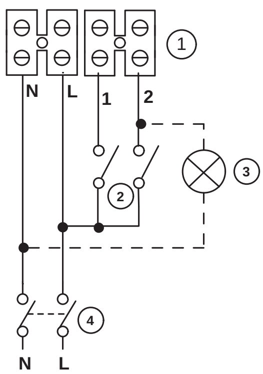
A) Terminal
B) Two-pole switch

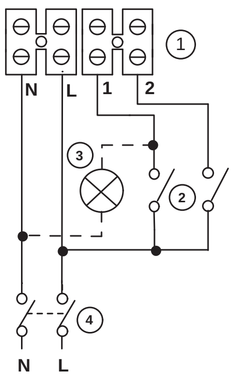


Punto Filo T Range
Punto Four T Range



Punto Evo TP
Punto Evo TP HCS

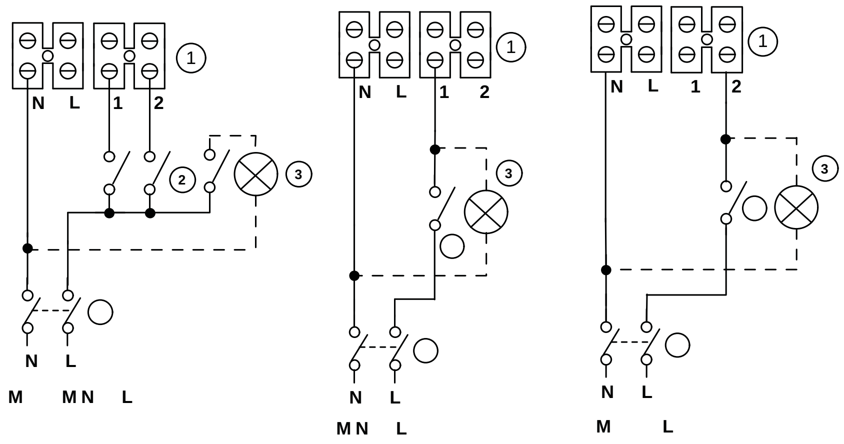




1. Terminal block
2. Max and min speed swtiches
3. Lamp
4. 2 poles switch

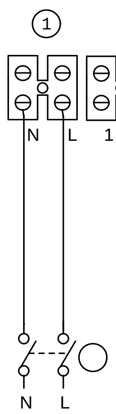
Punto Evo

N 1 Min speed
N 2 Max speed



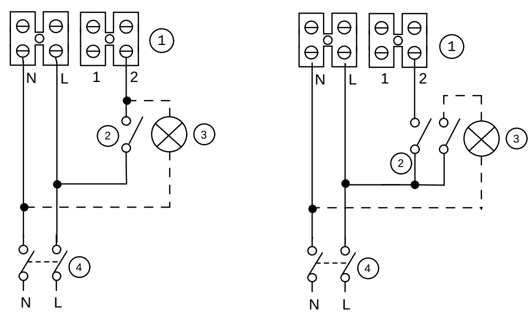
1. Morsettiere di colle amento Terminal block
2. nterr ttori per massima e minima elocit Max and min speed switches
3. Lampada Lamp
- nterr ttore bipolare 2 poles switch

Punto Evo T PIR



1. Terminal block
- 2 poles switch

Punto Evo T



1. Terminal block
2. peed swtiches
3. Lamp
4. 2 poles switch

Vortice Vario Range and Vortice Vario I Range

150/6" P - 230/9" P

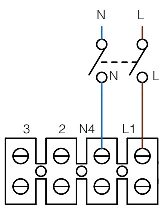
150/6" AR - 230/9" AR - 300/12" AR - 230/9" AR LL S
150/6" ARI LL S - 230/9" ARI LL S - 300/12" ARI LL S

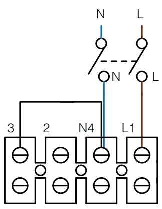
EXTRACTION

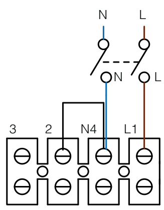
150/6" AR - 230/9" AR - 300/12" AR - 230/9" AR LL S
150/6" ARI LL S - 230/9" ARI LL S - 300/12" ARI LL S

VENTILATION

A) Terminal
B) Two-pole switch

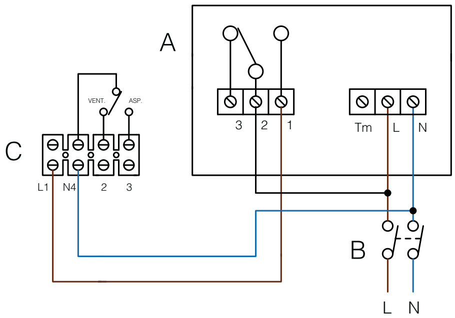




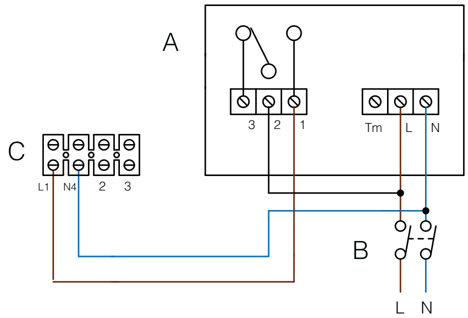


Vario sensors

A) C PIR
B) Two-pole switch
C) Vario terminal

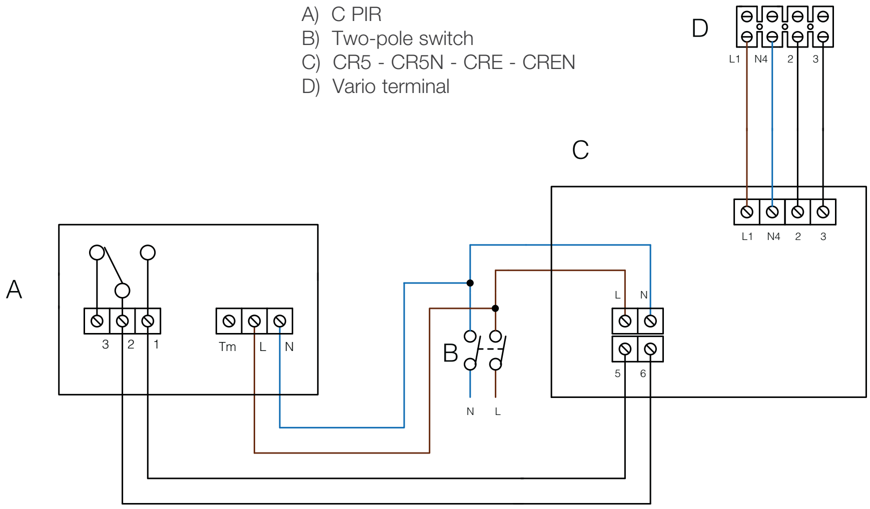


VARIO REVERSIBLE SERIES

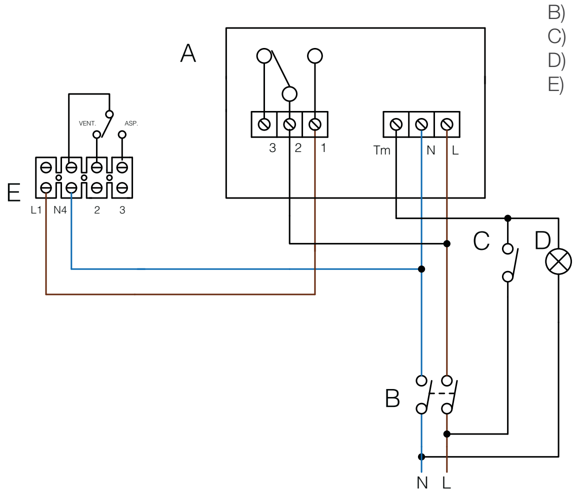


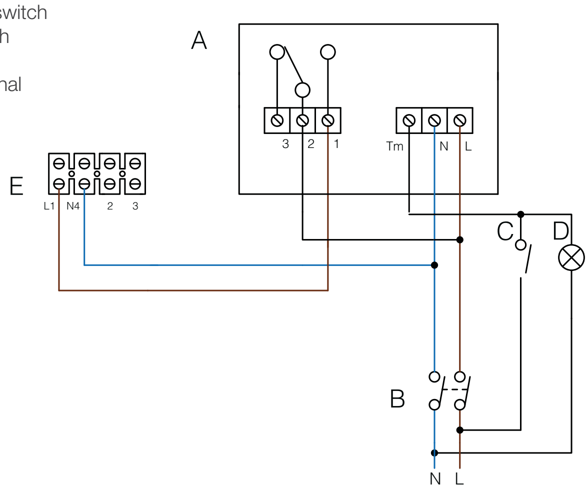
VARIO NON REVERSIBLE SERIES

A) C PIR
B) Two-pole switch
C) CR5 - CR5N - CRE - CREN
D) Vario terminal

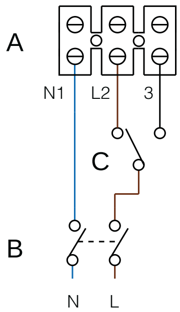


A) C T - C HCS
B) Two-pole switch
C) Light switch
D) Light
E) Vario terminal





Angol K



A) Terminal

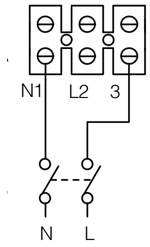
B) Two-pole switch

C) Switch

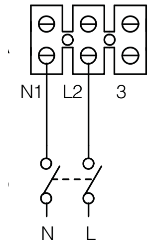
Vort Press Range
Vort Press I Range

A) Terminal Block
B) Two-pole switch
C) Switch

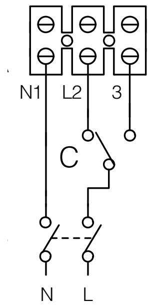
MINIMUM SPEED



MAX SPEED

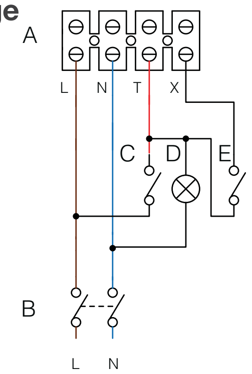


MIN/MAX SPEED



Vort Press T Range

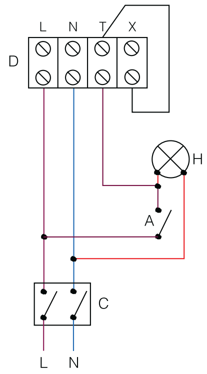
A) Terminal
B) Two-pole switch
C) Light switch
D) Light
E) Min/max speed switch



OPERATION:
with light on, max/min speed can be changed;
with light off (timer mode) minimum speed.

Vort Press I T Range

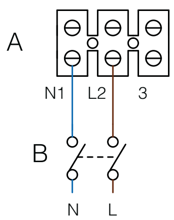
A) Terminal
B) Two-pole switch
C) Light switch
D) Light



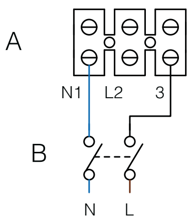
OPERATION:
with light on, max speed;
with light off (timer mode) minimum speed.

Ariett Habitat Range • Vort Press Habitat Range

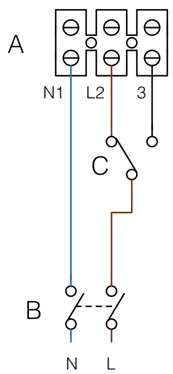
SPEED MAX



SPEED MIN

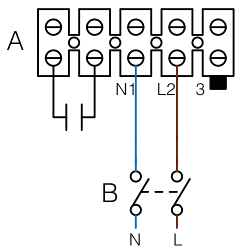


SPEED MIN/MAX

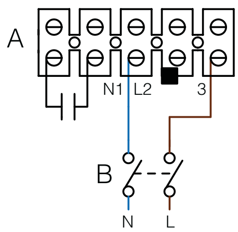


Vort Quadro Range

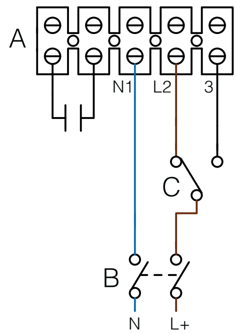
Maximum speed connection



Minimum speed connection



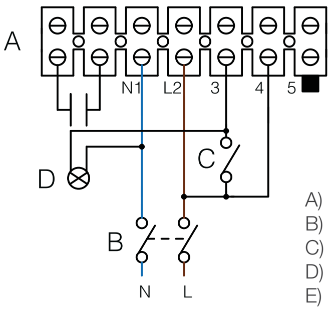
Min/max speed connection



A) Terminal block
B) Double pole switch
C) Min/max selector

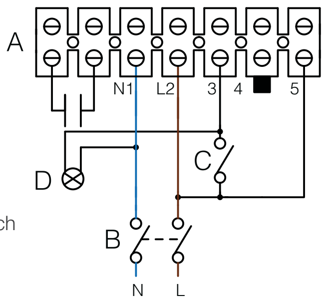
Vort Quadro THCS Range

Connection with timed maximum speed

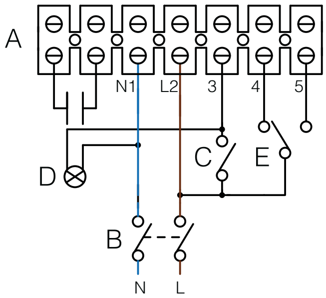


A) Terminal block
B) Double pole switch
C) Switch lamp
D) Lamp
E) Min/max selector

Connection with timed minimum speed

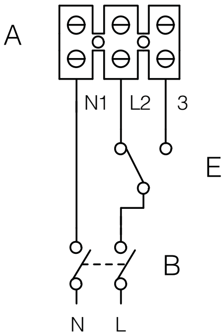


Connection with optional timing of minimum or maximum speed

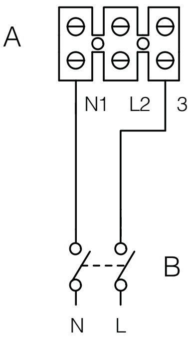


Vort Quadro Micro 100 ES • Vort Quadro Micro 100 I ES

Low/high speed

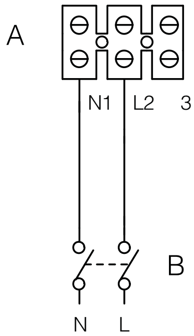


Low speed



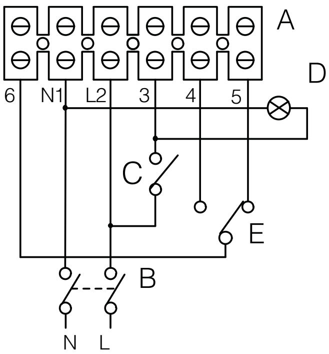
A) Terminal block
B) Switch
C) Switch lamp
D) Lamp
E) Min/max selector

High speed

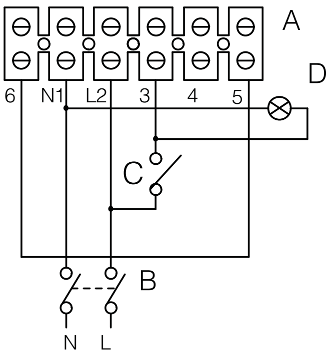


Vort Quadro Micro 100 T ES • Vort Quadro Micro 100 I T ES

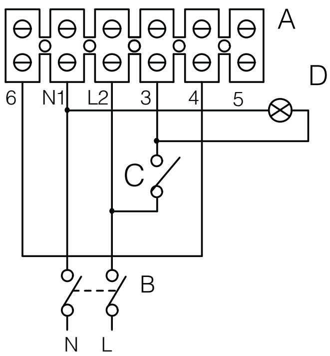
Low/high speed



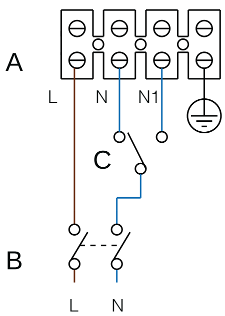
Low speed



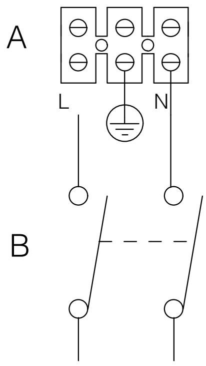
High speed



Vort Kappa Range



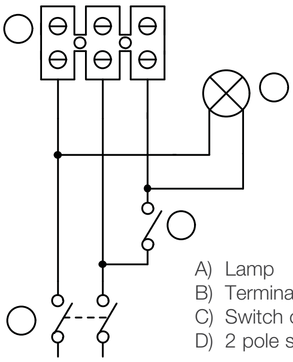
Kappe Vortice Range



A) Terminal block
B) Switch

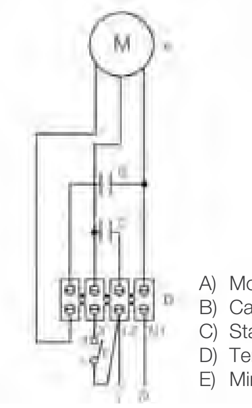
Vortice Range • Vortex Range

Vort Notus Range



A) Lamp
B) Terminal block
C) Switch of maximun speed
D) 2 pole switch

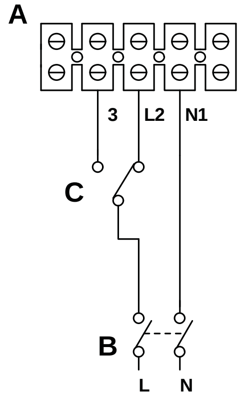
Vort Penta Range
Kit Vort Penta
Vort Platt Range



A) Motor
B) Capacitor-minimum speed
C) Start capacitor
D) Terminal block
E) Min/max speed selector

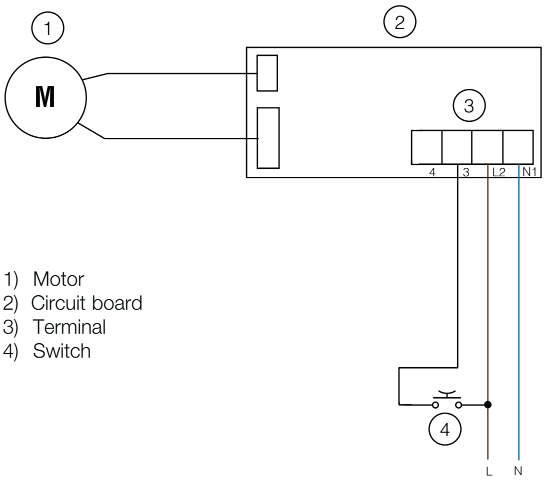
VMC Ariant

Low/high speed



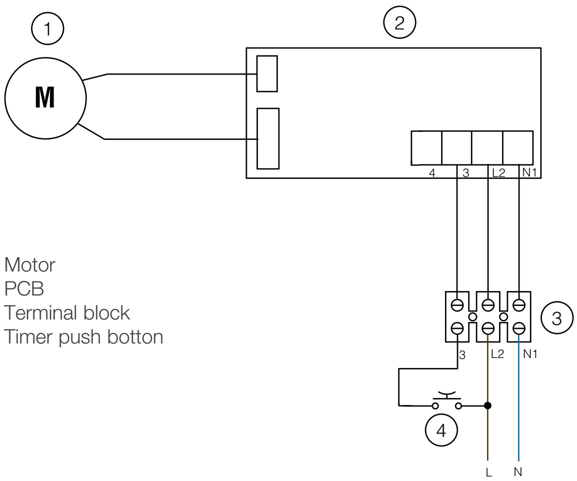
A) Terminal block
B) Two-pole switch
C) min/max switch

Vort Platt ES Range



1) Motor
2) Circuit board
3) Terminal
4) Switch

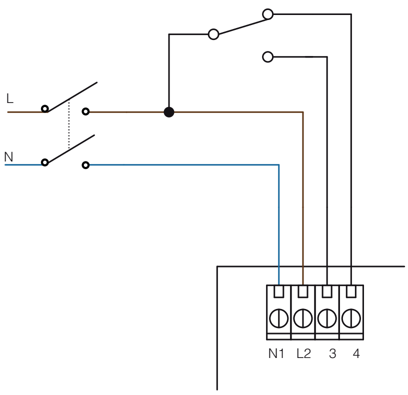
Vort Penta ES Range



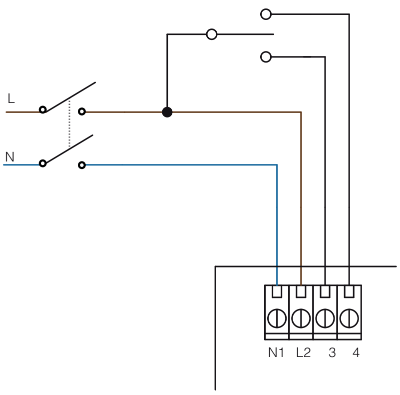
1) Motor
2) PCB
3) Terminal block
4) Timer push botton

Vort Leto MEV Range

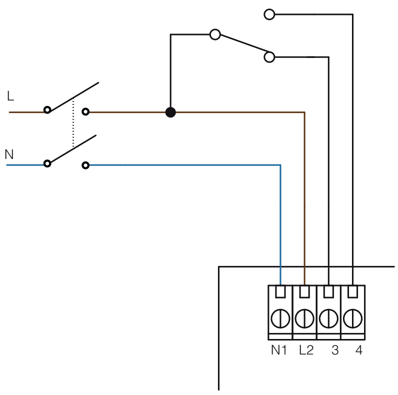
Minimum speed



Medium speed



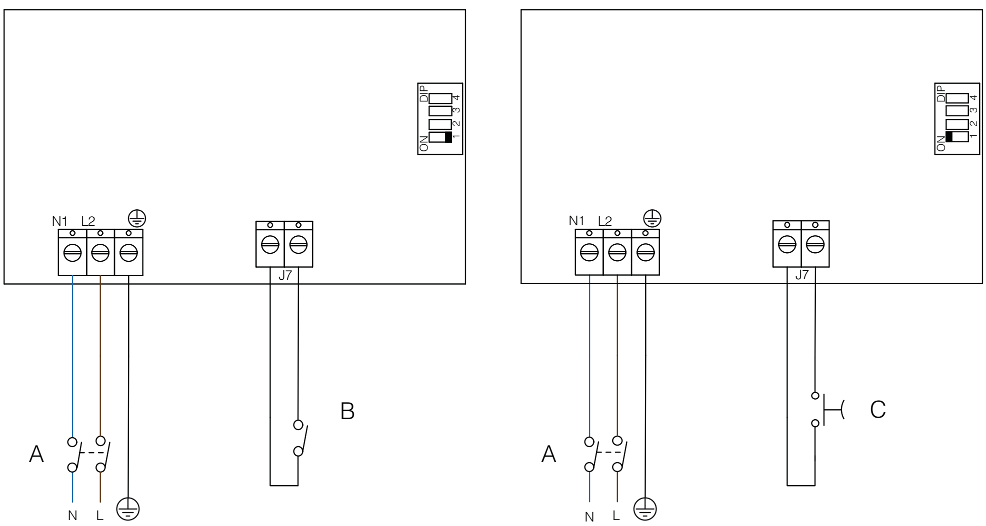
Maximum speed



Vort HR 200 Range

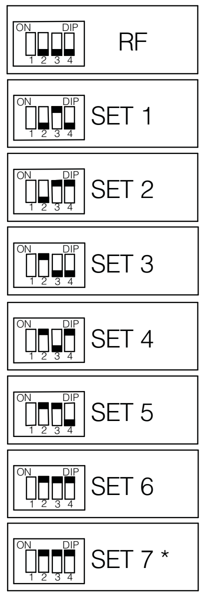
Max speed without timer

Max speed with timer



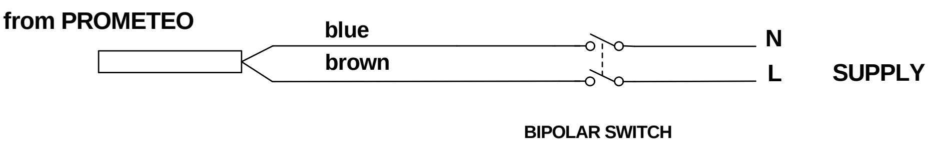
A) 2 Poles switch
B) Max speed switch
C) Push bottom N.O

SET CURVE

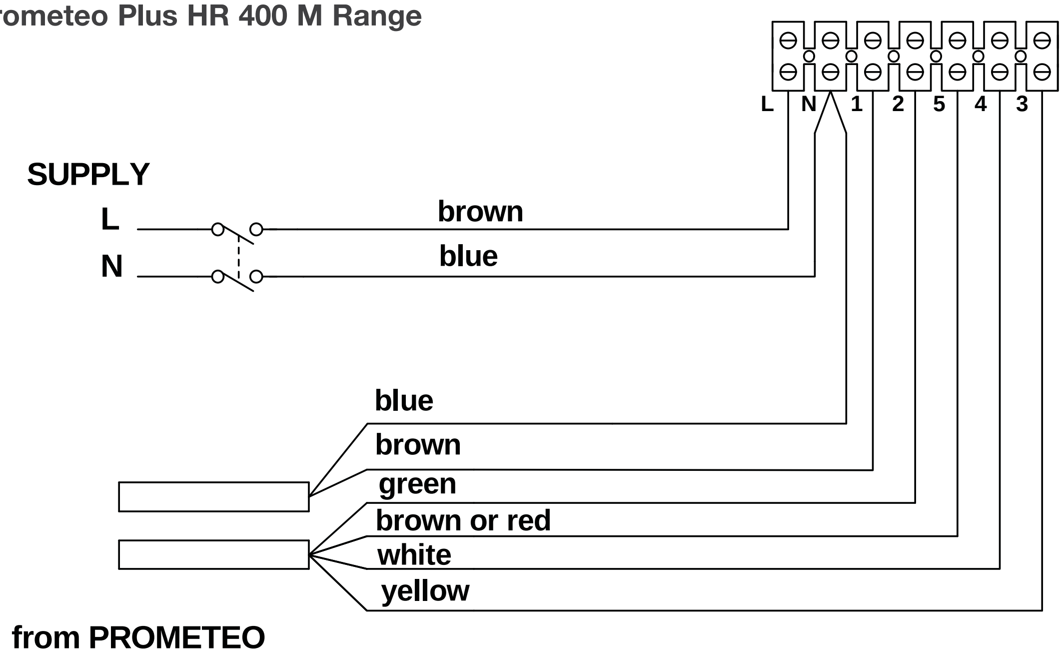


* trimmer set max

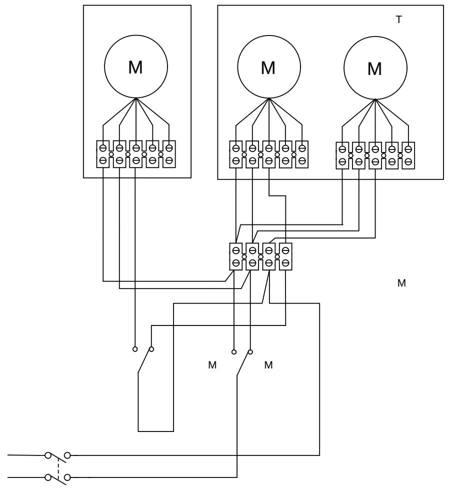
Vort Prometeo Plus HR 400



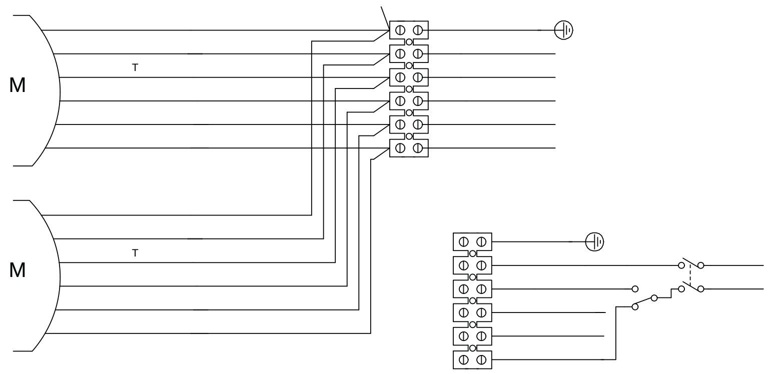
Vort Prometeo Plus HR 400 M Range



HRI ONE Range



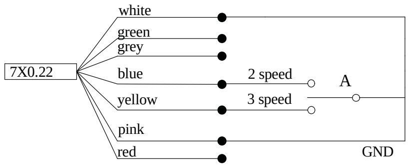
HRI TWO Range



HRI - E ONE • TWO Range

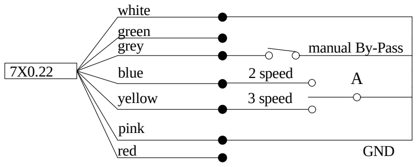
mod. HRI E ONE/TWO

CONNECTING WIRING WITHOUT REMOTE ON/OFF



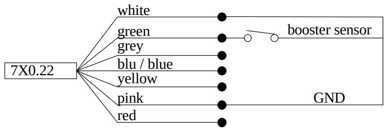
mod. HRI E ONE/TWO BP

FREE CONDUCTORS
PROPERLY INSULATE



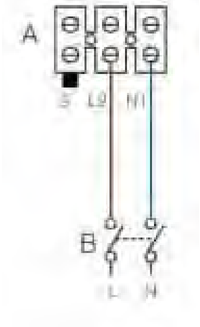
A: THREE-WAY SWITCH

HRI E ONE/TWO F

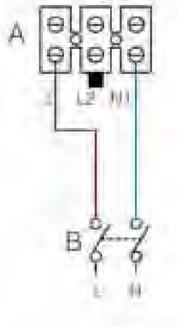


Lineo ES Range

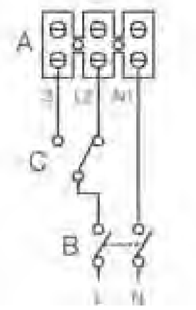
HIGH SPEED



LOW SPEED



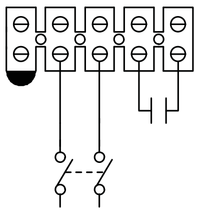
HIGH/LOW SPEED



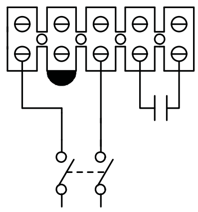
A) Terminal block
B) Double pole switch
C) Min/max selector

Lineo V0 Range

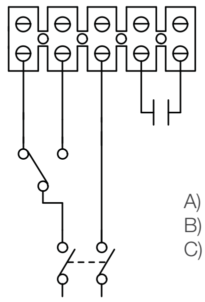
HIGH SPEED



LOW SPEED



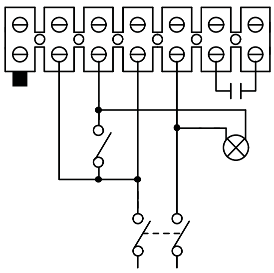
HIGH/LOW SPEED



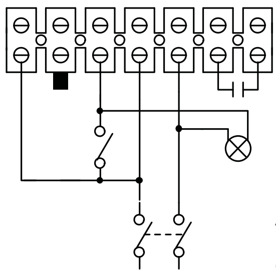
A) Terminal block
B) Switch
C) Switch

Lineo V0 T Range

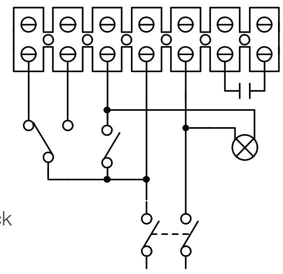
HIGH SPEED



LOW SPEED

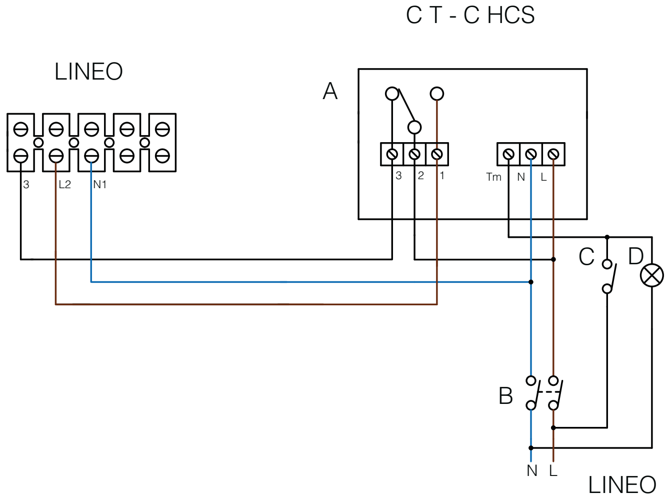


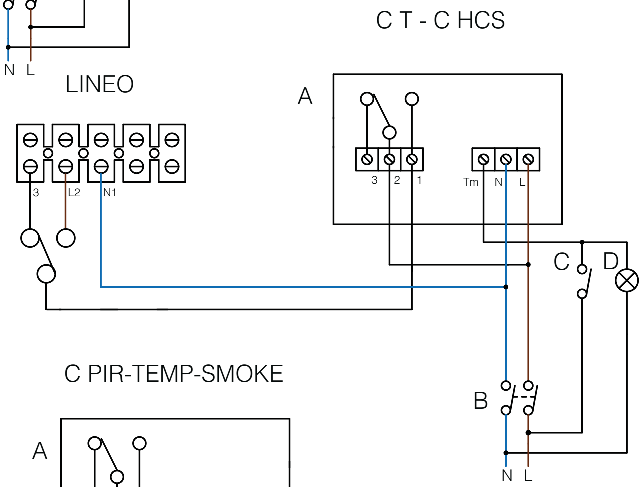
HIGH/LOW SPEED



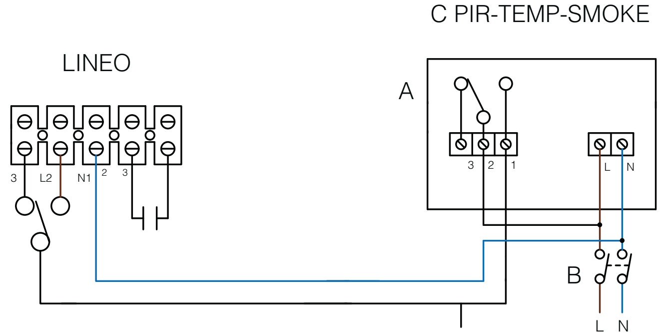
A) Terminal block
B) Switch
C) Lamp Switch
D) Lamp
E) Switch

Lineo Sensors

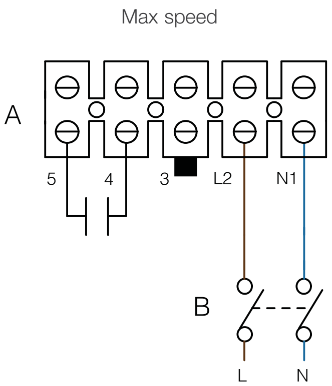


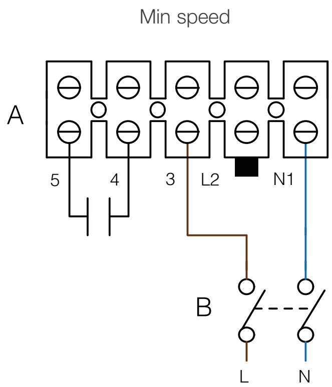


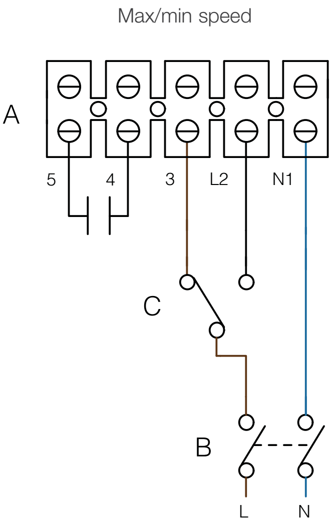
A) C T - C HCS
B) Isolation switch - double pole
C) Switch lamp
D) Lamp
A) Fan Terminal Block Vario



CA MD Range



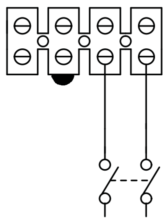




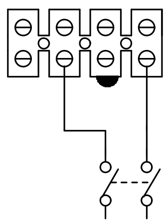
A) Terminal
B) Two-pole switch
C) Speed switch

CA MD E • CA MD E RF • CA MD E W 100 • CA MD E W 120 • CA MD E W • CA MD E W 150 Q

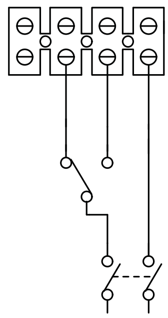
HIGH SPEED



LOW SPEED



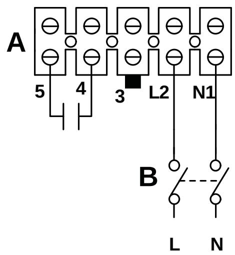
HIGH/LOW SPEED



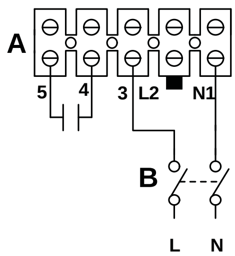
A) Terminal block
B) 2 poles switch
C) Slide switch high/low speed

CA MD E • CA MD E RF• CA MD E W 150 • CA MD E W 200 • CA MD E W 250 • CA MD E W 315

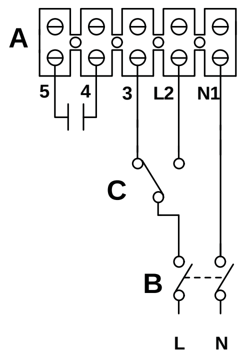
HIGH SPEED



LOW SPEED

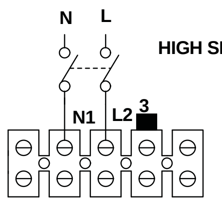


HIGH/LOW SPEED

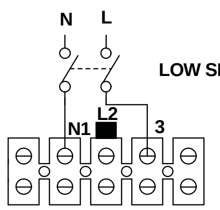


A) Terminal block
B) 2 poles switch
C) Slide switch high/low speed

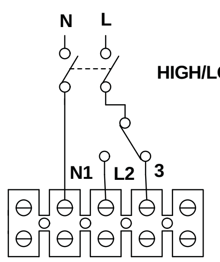
CA V0 D Range



HIGH SPEED

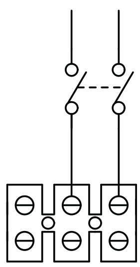


LOW SPEED



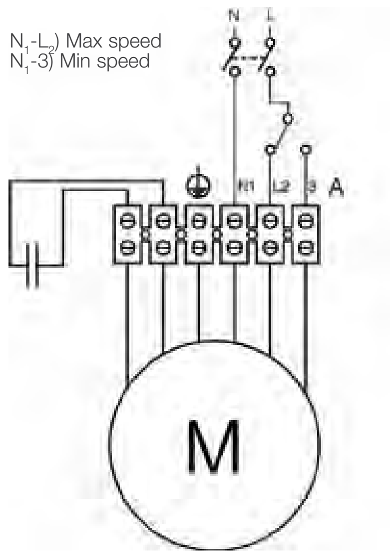
HIGH/LOW SPEED

CA V0 E Range



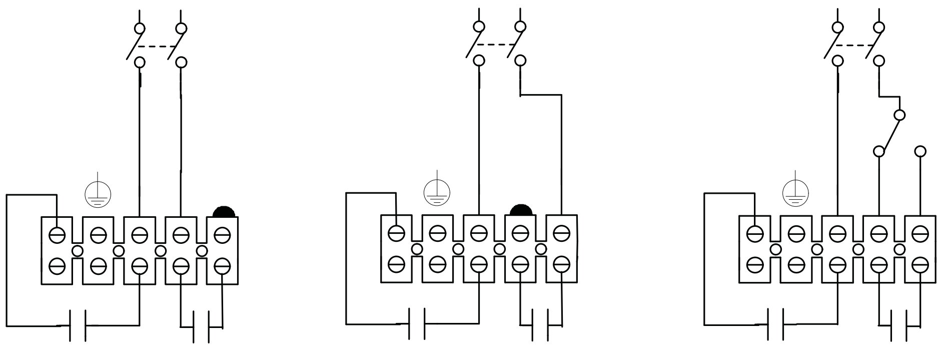
A) Terminal block
B) 2 poles switch

CA WE D Range



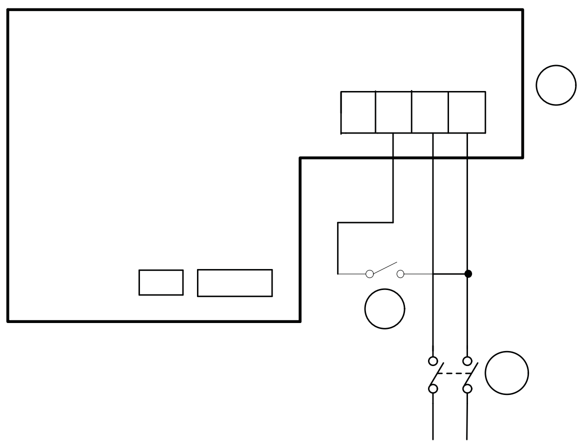
CA WE D E Range

HIGH SPEED LOW SPEED HIGH/LOW SPEED



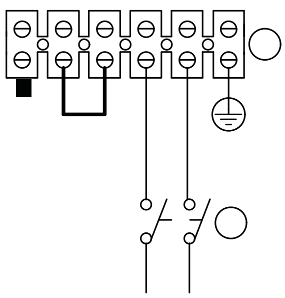
A) Terminal block
B) 2 poles switch
C) Slide switch high/low speed

CA 100 ES • CA 125 ES • CA 150 Q ES • CA 150 ES • CA 160 ES • CA 200 ES

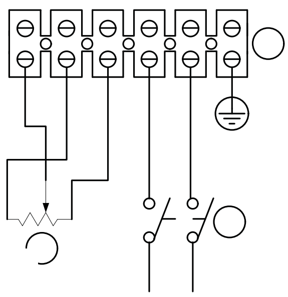


1) PCB
2) SWITCH
3) SWITCH

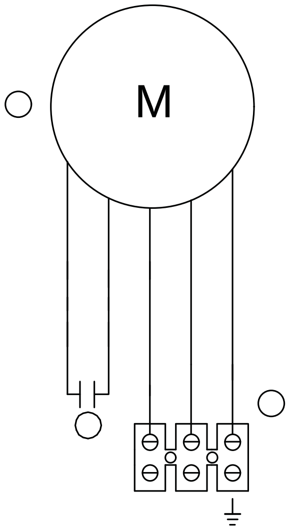
CA 250 ES • CA 315 ES



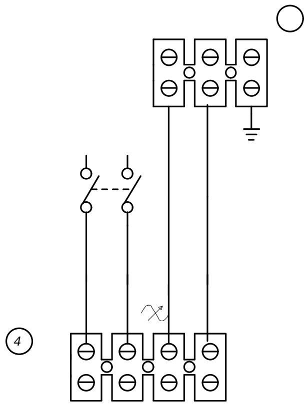
1) Trimmer block
2) Terminal block
3) 2 poles switch



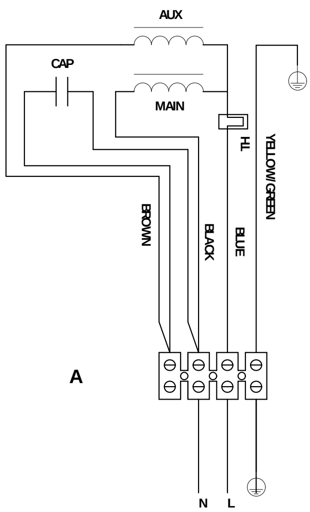
TIRACAMINO



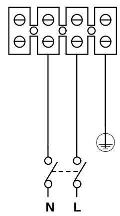
1) Motor
2) Terminal block
3) Capacitor 4μF/450V
4) Terminal block C1.5



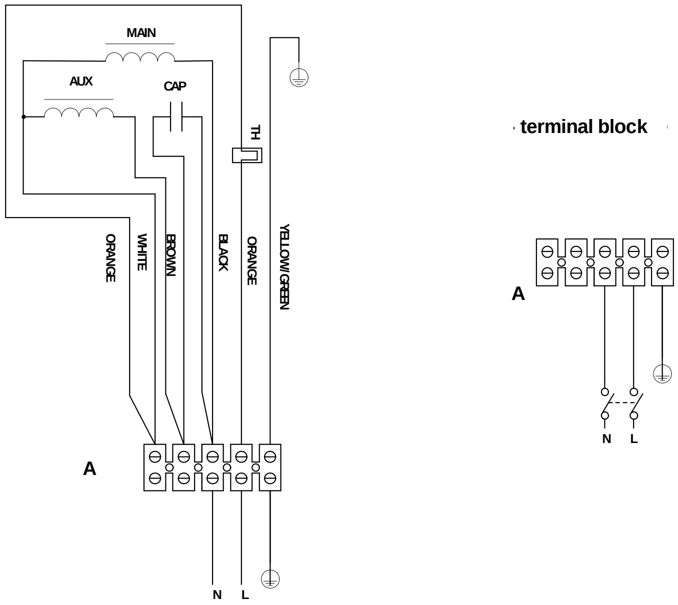
Vort QBK Range • Vort QBK SAL Range
Vort QBK 1000
Vort QBK COMFORT 1000
Vort QBK SAL 1000



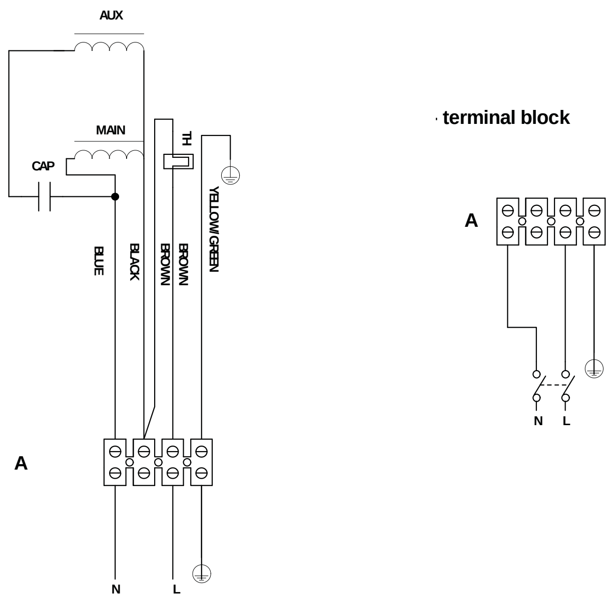
terminal block



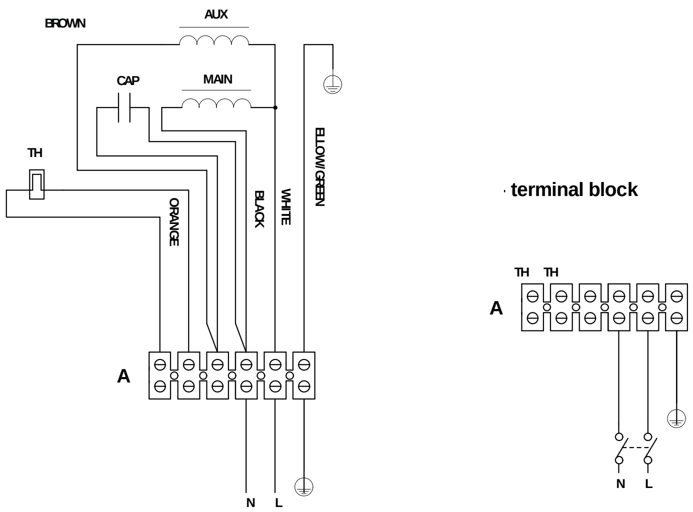
Vort QBK 7/7 4P
Vort QBK 9/9 6P
Vort QBK COMFORT 7/7 4P
Vort QBK COMFORT 9/9 6P
Vort QBK SAL 7/7 4P
Vort QBK SAL 9/9 6P



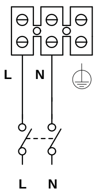
Vort QBK 9/9 4P
Vort QBK COMFORT 9/9 4P
Vort QBK SAL 9/9 4P



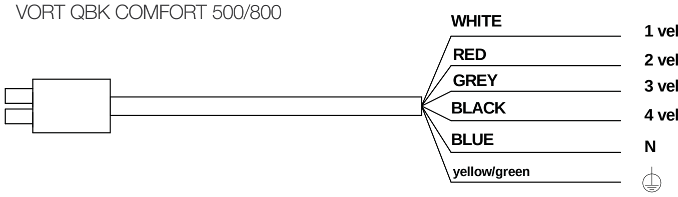
Vort QBK 10/10 6P
Vort QBK COMFORT 10/10 6P
Vort QBK SAL 10/10 6P



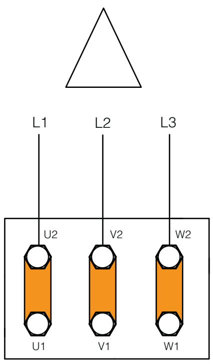
VORT QBK 10/10 4P
VORT QBK 12/12
VORT QBK COMFORT 10/10 4P
VORT QBK COMFORT 12/12
VORT QBK SAL 10/10 4P
VORT QBK SAL 12/12



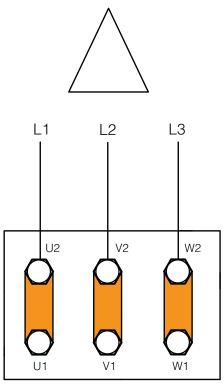
VORT QBK COMFORT 500/800



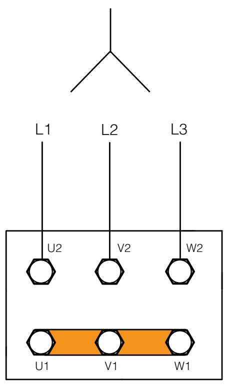
VORT QBK POWER Range



1 SPEED (5 KW)

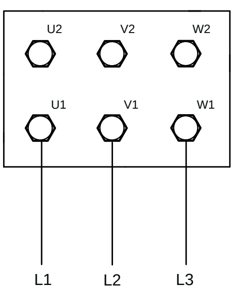


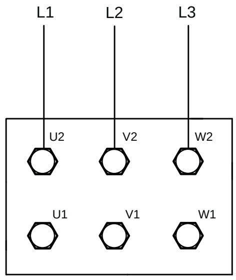
1 SPEED



2 SPEEDS

LOW SPEED

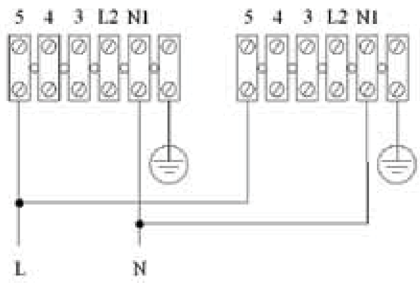




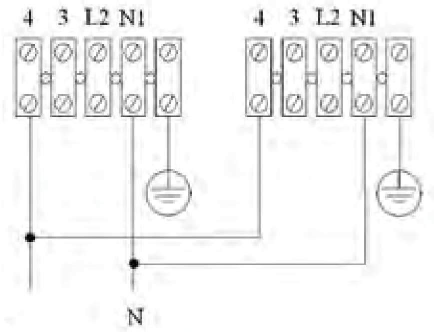
MAX SPEED

NRG Range

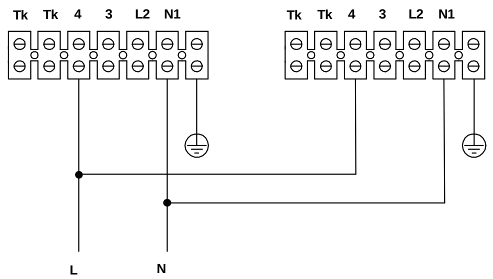
NRG 500-800-1200



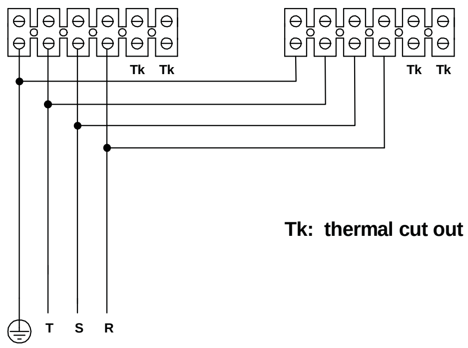
NRG 2000-2500



NRG 3000

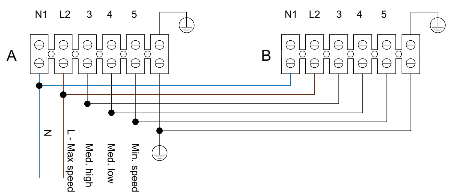


NRG 4000-5000-6000



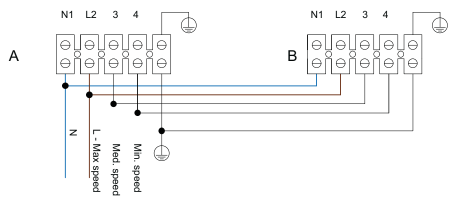
NRG V Range

NRG V 500



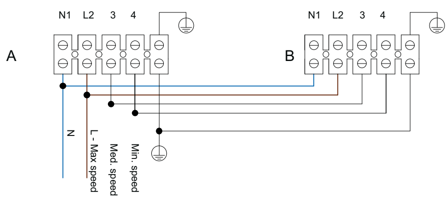
A-B) Terminal Block

NRG V 1000



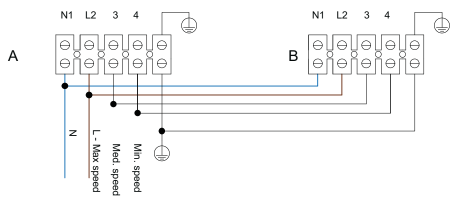
A-B) Terminal Block

NRG V 2000



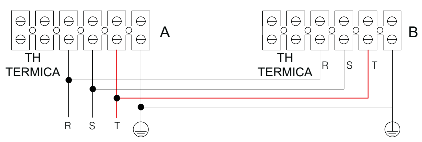
A-B) Terminal Block

NRG V 3000



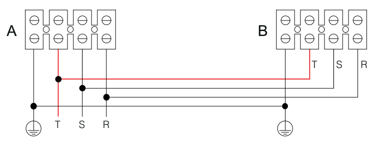
A-B) Terminal Block

NRG V



A-B) Terminal Block

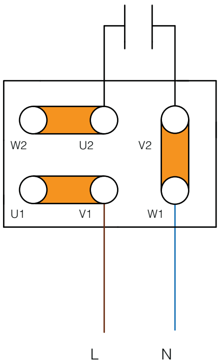
NRG V 6000



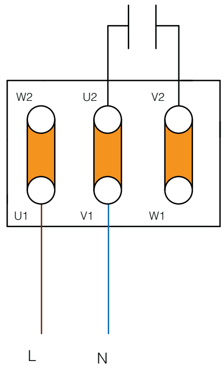
A-B) Terminal Block

VORTICEL E Range

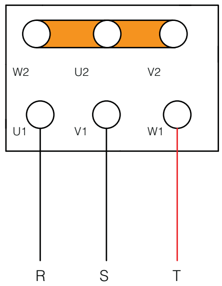
SINGLE-PHASE 2 POLES
(with IRM)



SINGLE-PHASE 4 POLES
(with IRM)

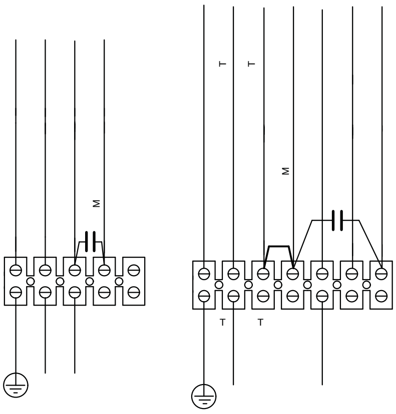


THREE-PHASE
(with IRT)

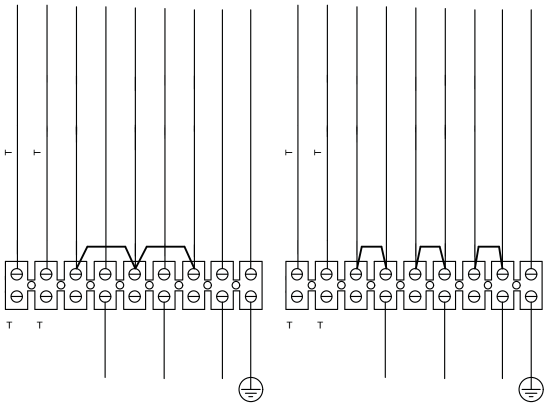


VORTICEL A-E

SINGLE-PHASE



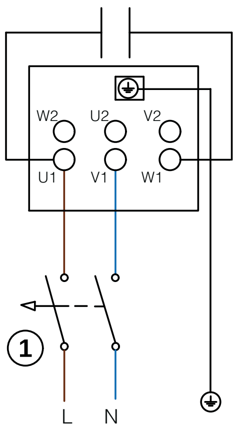
THREE-PHASE



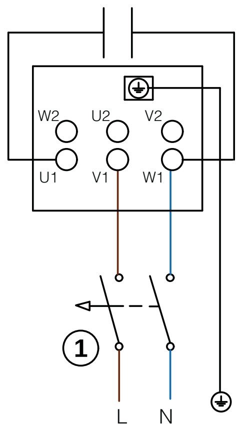
E ATEX • C ATEX Range

SINGLE-PHASE

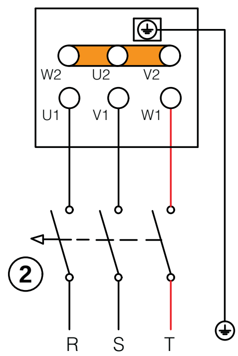
clockwise rotation



anti-clockwise rotation



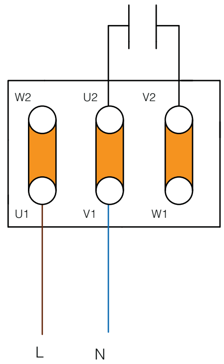
THREE-PHASE



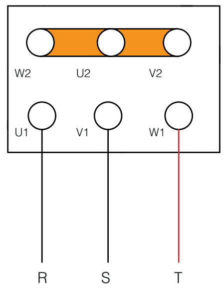
1) ATEX approved two-pole magneto-thermal switch: II (2) G/D
2) ATEX approved three-pole magneto-thermal switch: II (2) G/D

VORTICEL MP Range

SINGLE-PHASE
(with IRM)

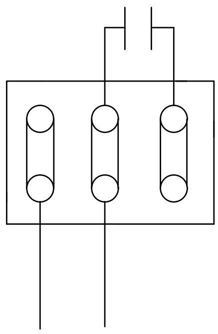


THREE-PHASE
(with IRT)

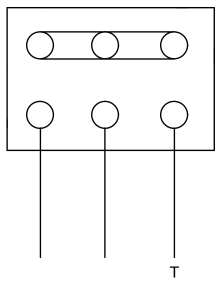


VORTICEL MPC-E

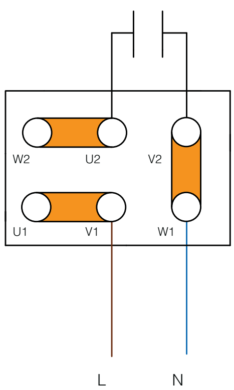
SINGLE-PHASE
(with IRM)



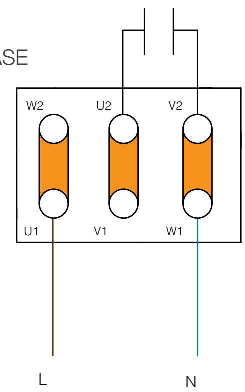
THREE-PHASE
(with IRT)



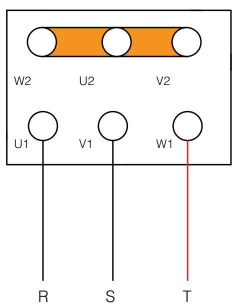
VORTICENT C Range



SINGLE-PHASE



THREE-PHASE



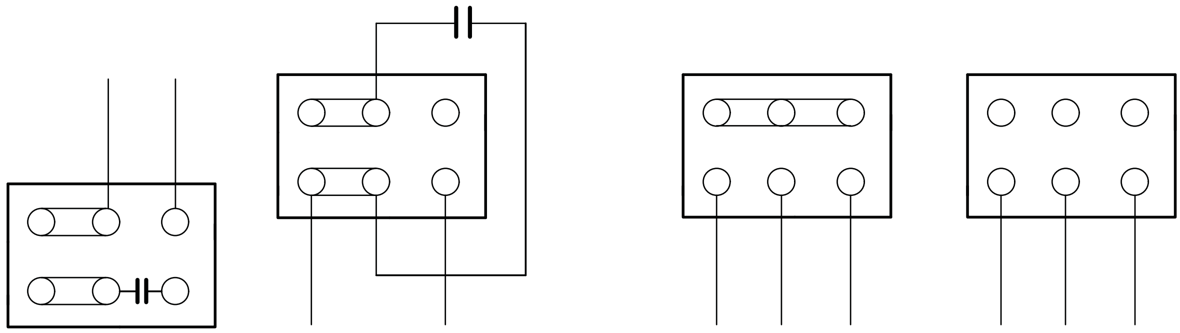
C 10/2 M - C 15/2 M - C 30/2 M
C 30/4 M - C 35/4 M
C 37/4 M - C 40/4 M

C 20/2 M - C 25/2 M

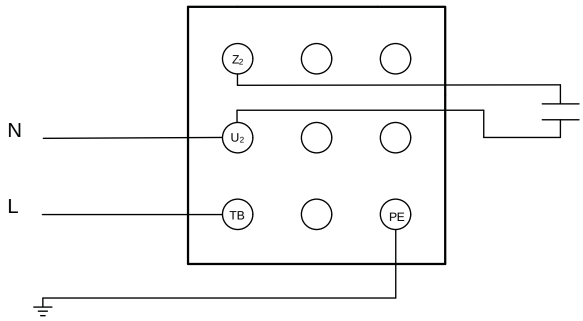
C 10/2 T - C 15/2 T - C 20/2 T - C 25/2 T
C 30/2 T - C 30/4 T - C 31/4 T - C 35/4 T
C 37/4 T - C 40/4 T - C 45/4 T - C 46/4 T

VORTICENT C E Range

SINGLE-PHASE THREE-PHASE

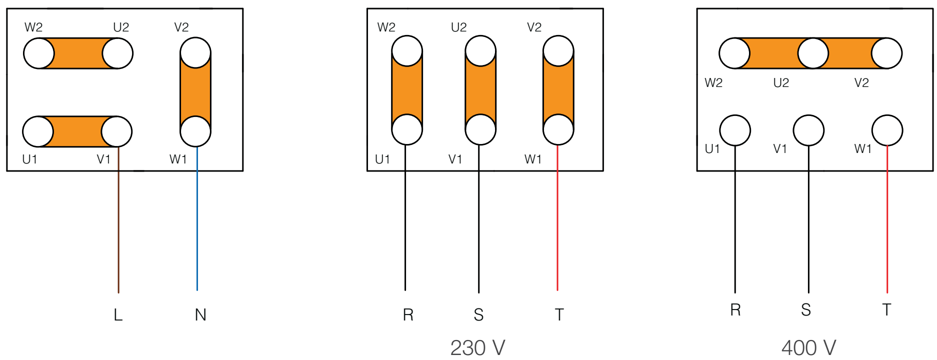


TORRETTE RF EU Range



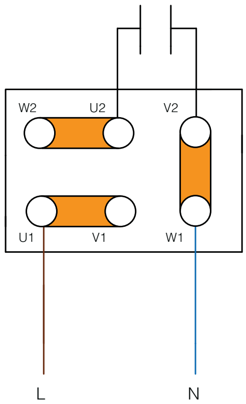
TORRETTE TR E Range • TORRETTE TR E-V Range

SINGLE-PHASE THREE-PHASE THREE-PHASE

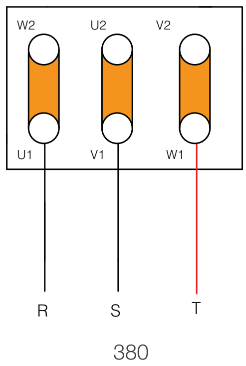


TORRETTE TR ED Range • TORRETTE TR ED-V Range

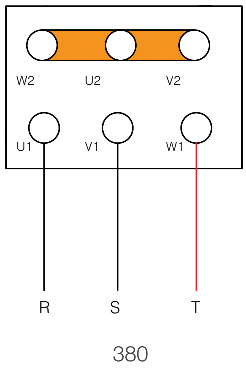
SINGLE-PHASE



THREE PHASE (max speed)

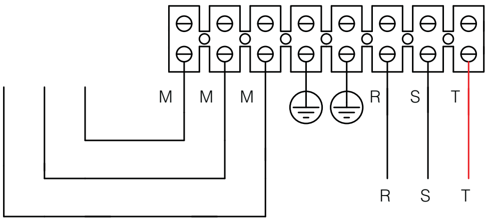


THREE PHASE (min speed)

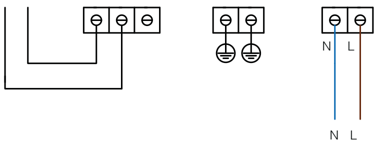


REGULATORS

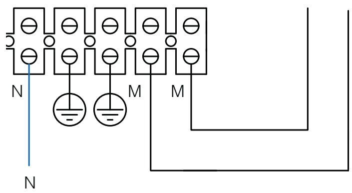
IRT



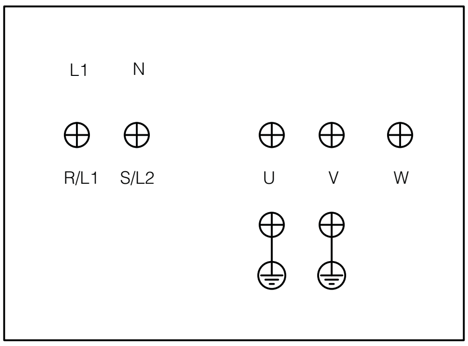
IREM



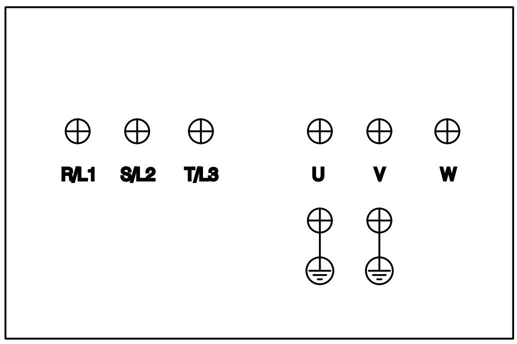
IRM



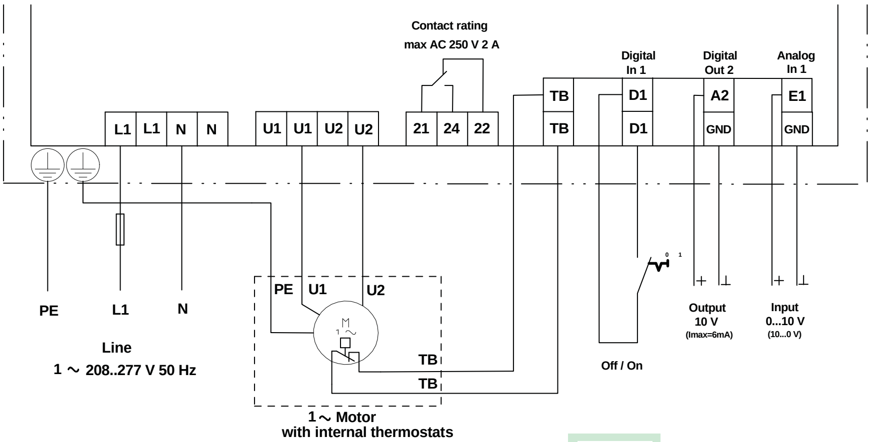
IREM INVERTER



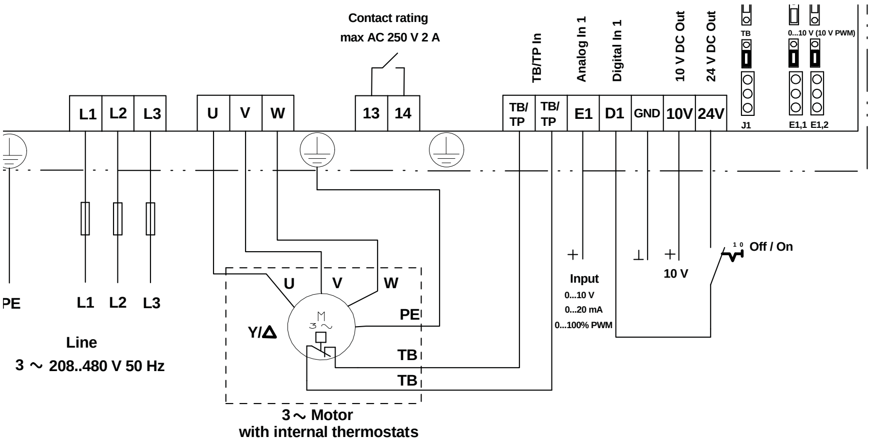
IRET INVERTER



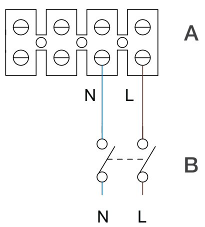
IREM INVERTER 4 M • IREM INVERTER 6 M



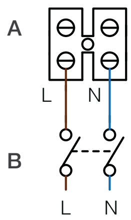
IRET INVERTER 2.5 AM • IRET INVERTER 5 AM



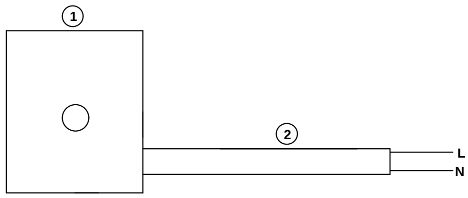
METAL DRY Range	VORTDRY Range	EASY DRY DUAL Range
METAL DRY ULTRA A	VORTDRY 1000 JET	
METAL DRY SUPER A	VORT FOHN 1200 Range	
OPTIMAL Range	VORT FOHN 1600 Range	
OPTIMAL DRY R A	PREMIUM S DISPENSER	
OPTIMAL DRY METAL		
PREMIUM Range		



A) Terminal
B) Two-pole switch

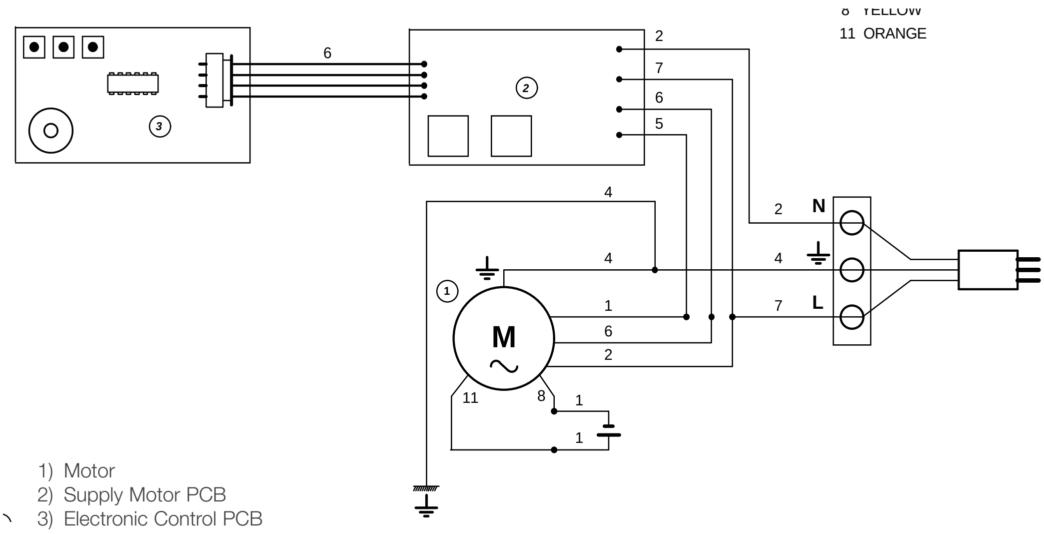


A) Terminal
B) Two-pole switch



1) Appliance
2) Supply Cable

AIR DOOR Range

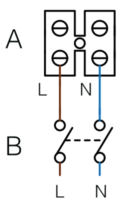


1) Motor
2) Supply Motor PCB
3) Electronic Control PCB

CEILING FANS

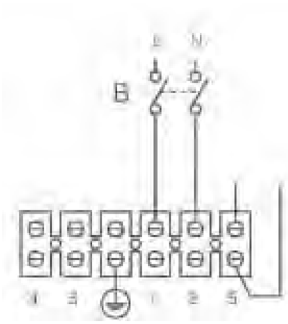
A) Fan Terminal Block
B) Isolation switch - double pole
C) Switch lamp
D) Selector reversibility

GORDON WALL Range

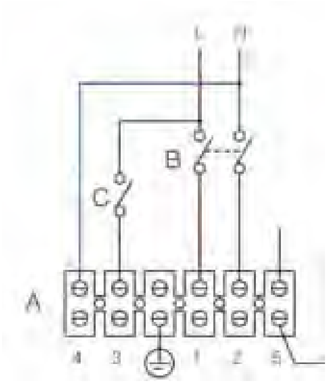


A) Fan Terminal Block
B) Isolation switch - double pole

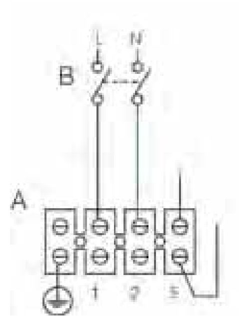
NORDIK DECOR 1S Range



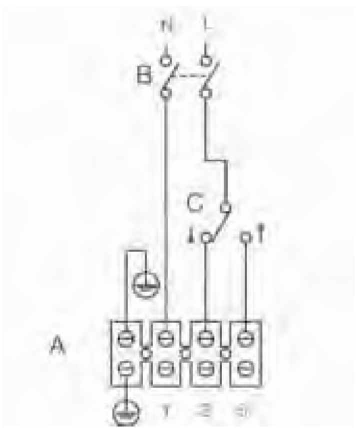
NORDIK DECOR (with light) NORDIK DESIGN 1S/1SL (with light)



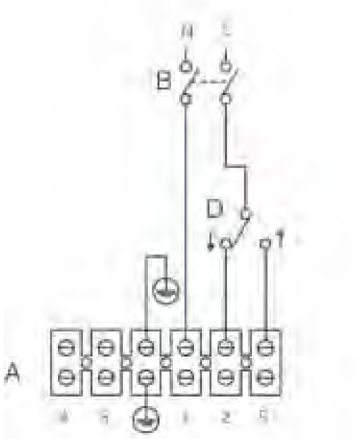
NORDIK DESIGN 1S/1SL Ranget)



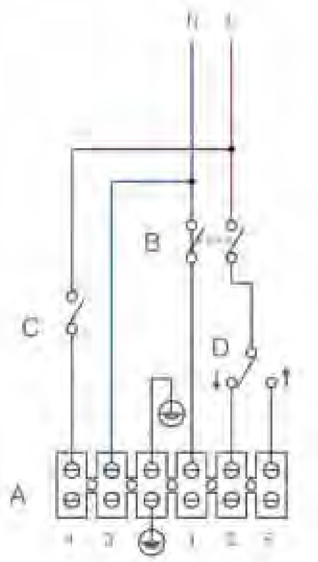
NORDIK INTERNATIONAL PLUS Range



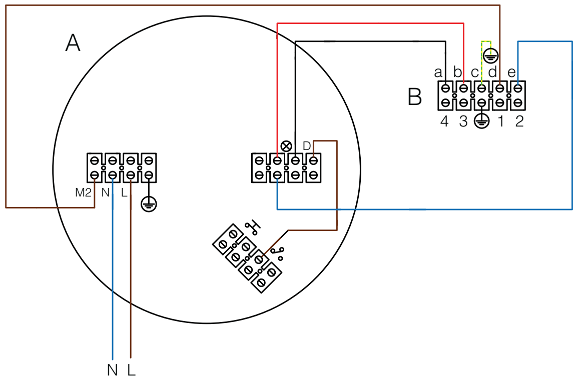
NORDIK EVOLUTION Range



NORDIK EVOLUTION Range (with light)

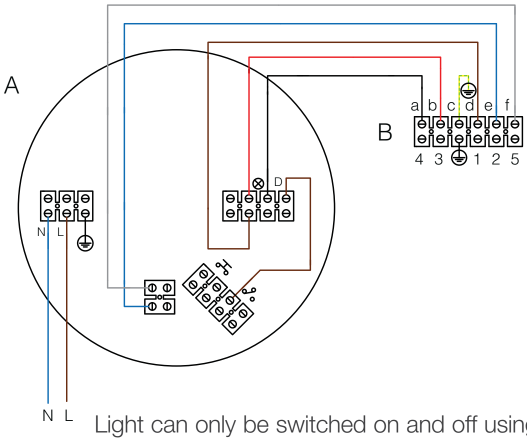


TELENORDIK 5T



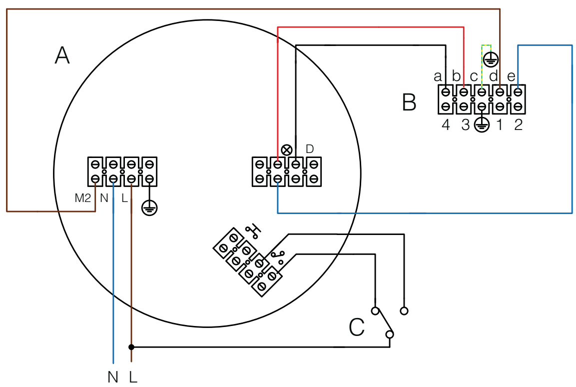
A) Remote control receiver
B) Fan terminal

TELENORDIK 5TR



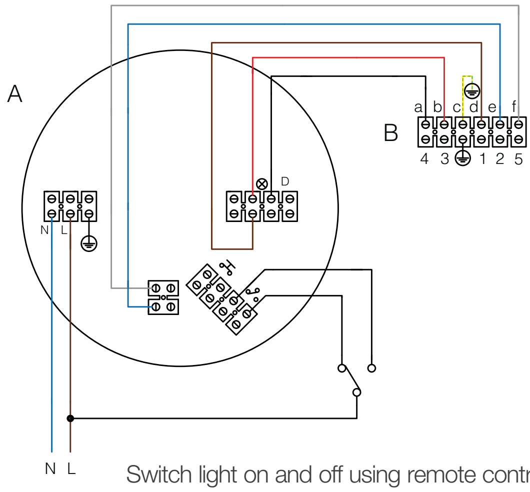
Light can only be switched on and off using the transmitter

TELENORDIK 5T



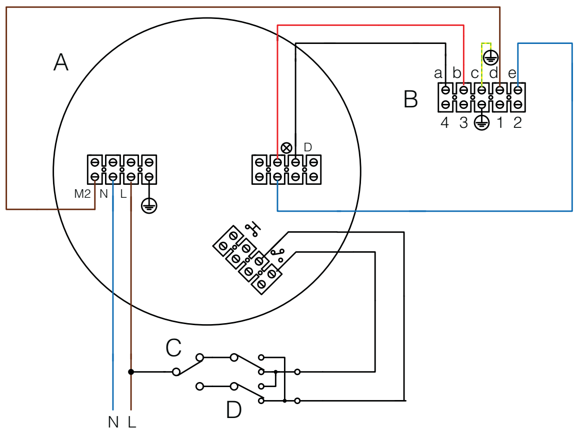
A) Remote control receiver
B) Fan terminal
C) Switch

TELENORDIK 5TR



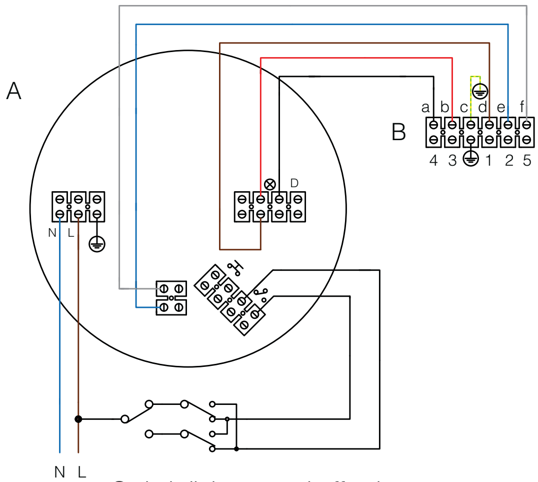
Switch light on and off using remote control transmitter and a variator

TELENORDIK 5T



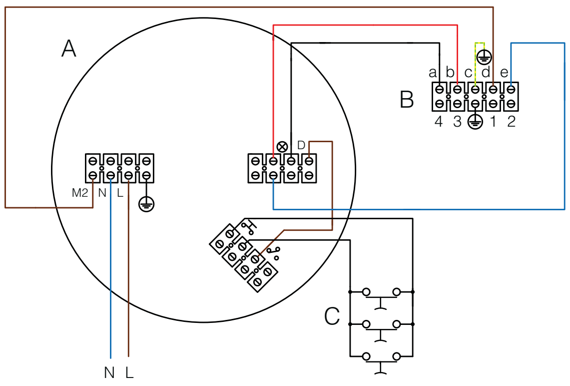
A) Remote control receiver
B) Fan terminal
C) Switch
D) Inverter

TELENORDIK 5TR



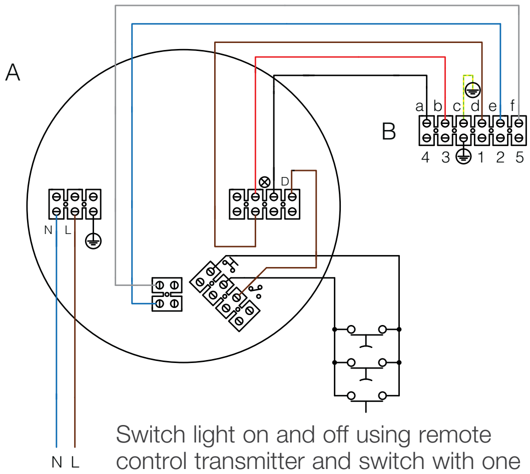
Switch light on and off using remote control transmitter and switch with one or more inverters

TELENORDIK 5T



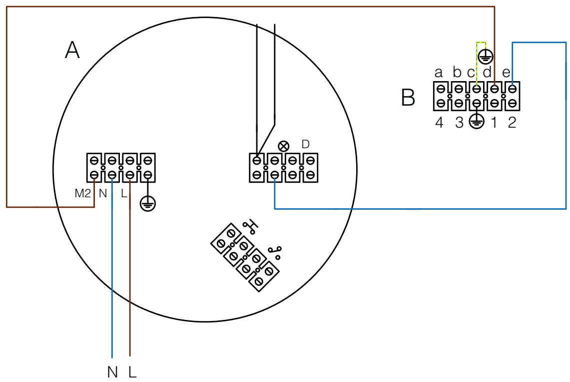
A) Remote control receiver
B) Fan terminal
C) Pushbutton

TELENORDIK 5T R

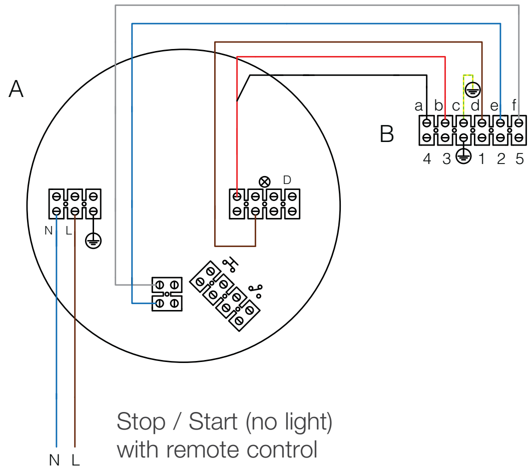


Switch light on and off using remote control transmitter and switch with one or more pushbuttons

TELENORDIK 5T

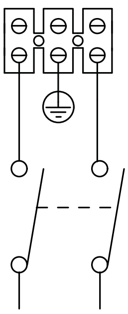


TELENORDIK 5T R



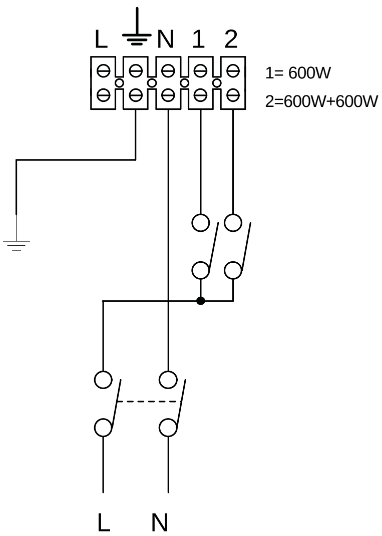
Stop / Start (no light) with remote control

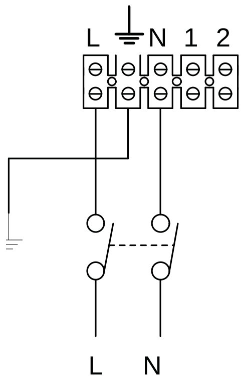
MICRORAPID Range
MICROSOL Range
THERMOLOGIKA Range



A) Terminal block
B) Switch

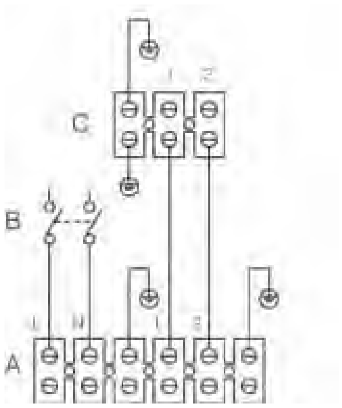
THERMOLOGIKA DESIGN Range



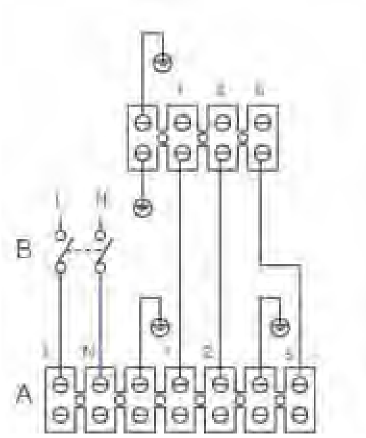


Regulators

SCNR/M

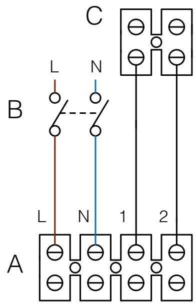


SCRR/M

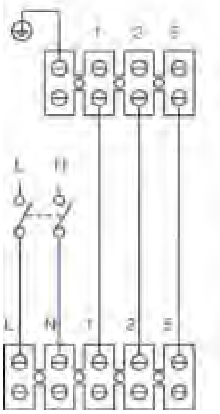


SCNR5
SCNR
C5 0.5

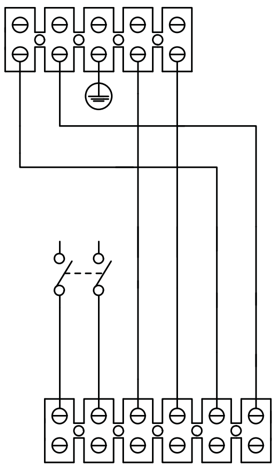
A)Terminal
B) Two-pole switch
C) Fan terminal



SCRR5

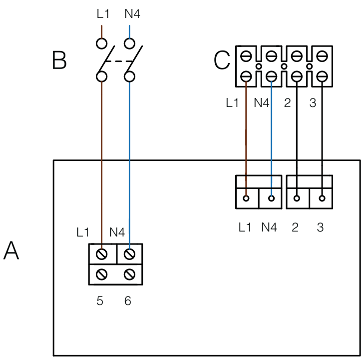


SCRRL5



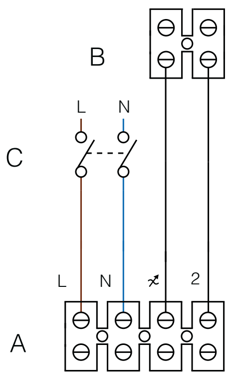
A)Terminal
B) Two-pole switch
C) Fan terminal

CR5 • CRN • CR5N • CREN



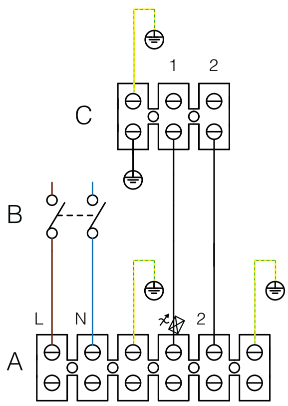
A) CR5N - CREN
B) Two-pole switch
C) Vario terminal

C 1.5

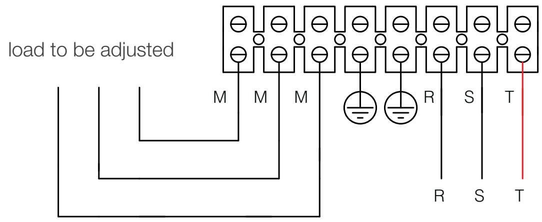


A) Terminal
B) Two-pole switch
C) Fan terminal

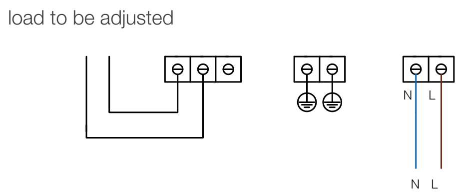
C 2.5



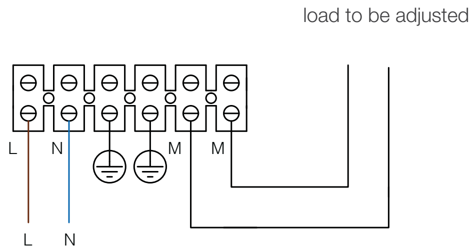
IRT



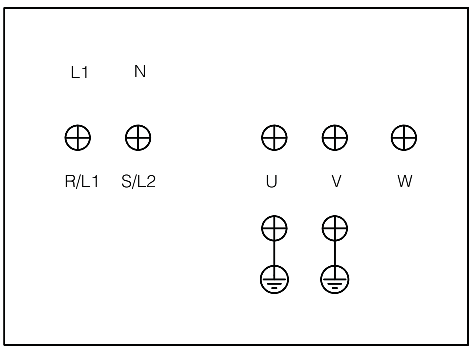
IREM



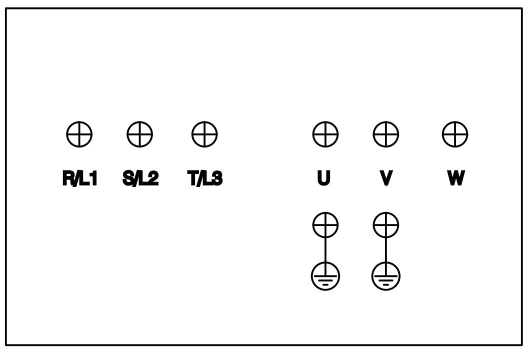
IRM



IREM INVERTER



IRET INVERTER



Predstavništvo za Srbiju
AIRTREND Ltd.
Kumanovska 14
11000 Beograd, Srbija
Telefon +381 (0)11 383 6886, 308 5740
Telefax +381 (0)11 344 4113
E-mail gobrid@eunet.rs
www.airtrend.rs

Distribucija i prodaja
KOVENT
Kumanovska 14
Tel: 011 383 6886, 308 5740
Fax: 011 344 4113
E-mail office@kovent.rs
www.kovent.rs